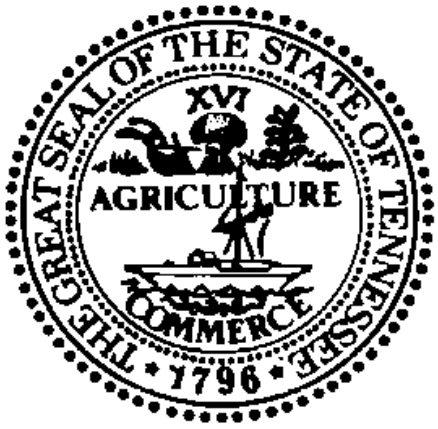

TENNESSEE DEPARTMENT

OF

ENVIRONMENT AND CONSERVATION

DOE OVERSIGHT DIVISION

ENVIRONMENTAL MONITORING PLAN

JANUARY through DECEMBER 2007

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LIST OF COMMON ACRONYMS AND ABBREVIATIONS

ASER	Annual Site Environmental Report (written by DOE)
ASTM	American Society for Testing and Materials
BCK	Bear Creek Kilometer (station location)
BFK	Brushy Fork Creek Kilometer (station location)
BJC	Bechtel Jacobs Company
BMAP	Biological Monitoring and Abatement Program
BNFL	British Nuclear Fuels Limited
BOD	Biological Oxygen Demand
BWXT	Y-12 Prime Contractor (current)
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAP	Citizens Advisory Panel (of LOC)
CCR	Consumer Confidence Report
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminants of Concern
COD	Chemical Oxygen Demand
CPM (cpm)	Counts per Minute
CRM	Clinch River Mile
CROET	Community Reuse Organization of East Tennessee
CWA	Clean Water Act
CYRTF	Coal Yard Runoff Treatment Facility (at ORNL)
D&D	Decontamination and Decommissioning
DOE	Department of Energy
DOE-O	Department of Energy-Oversight Division (TDEC)
DWS	Division of Water Supply (TDEC)
E. coli	Escherichia coli
EAC	Environmental Assistance Center (TDEC)
ED1, ED2, ED3	Economic Development Parcel 1, Parcel 2, and Parcel 3
EFPC	East Fork Poplar Creek
EMC	Environmental Monitoring and Compliance (DOE-O Program)
EMWMF	Environmental Management Waste Management Facility
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera (May flies, Stone flies, Caddis flies)
ERAMS	Environmental Radiation Ambient Monitoring System
ET&I	Equipment Test and Inspection
ETTP	East Tennessee Technology Park
FDA	U.S. Food and Drug Administration
FRMAC	Federal Radiation Monitoring and Assessment Center
g	Gram
GHK	Gum Hollow Branch Kilometer (station location)
GIS	Geographic Information Systems
GPS	Global Positioning System
GW	Ground Water
GWQC	Ground Water Quality Criteria
HAP	Hazardous Air Pollutant
HCK	Hinds Creek Kilometer (station location)
IBI	Index of Biotic Integrity
IC	In Compliance
"ISCO" Sampler	Automatic Water Sampler
IWQP	Integrated Water Quality Program
K-####	Facility at K-25 (ETTP)
K-25	Oak Ridge Gaseous Diffusion Plant (now called ETTP)
KBL	Knoxville Branch Laboratory

KFO	Knoxville Field Office
L	Liter
LC_{50}	Lethal Concentration at which 50 % of Test Organisms Die
LMES	Lockheed Martin Energy Systems (past DOE Contractor)
LOC	Local Oversight Committee
LWBR	Lower Watts Bar Reservoir
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MBK	Mill Branch Kilometer (station location)
MCL	Maximum Contaminant Level (for drinking water)
MDC	Minimum Detectable Concentration
MEK	Melton Branch Kilometer (station location)
µg	Microgram
mg	Milligram
MIK	Mitchell Branch Kilometer (station location)
ml	Milliliter
MMES	Martin Marietta Energy Systems (past DOE Contractor)
µmho	Micro mho (mho=1/ohm)
MOU	Memorandum of Understanding
mR	Microroentgen
mrem	1/1000 of a rem – millirem
N, S, E, W	North, South, East, West
NAAQS	National Ambient Air Quality Standards
NAREL	National Air and Radiation Environmental Laboratory
NAT	No Acute Toxicity
NEPA	National Environmental Policy Act
NIC	Not In Compliance
NOAEC	No Observable Adverse Effect Concentration (to Tested Organisms)
NOV	Notice of Violation
NPDES	National Pollution Discharge Elimination System
NRWTF	Non-Radiological Waste Treatment Facility (at ORNL)
NT	Northern Tributary of Bear Creek in Bear Creek Valley
OMI	Operations Management International (runs utilities at ETTP under CROET)
OREIS	Oak Ridge Environmental Information System http://www-oreis.bechteljacobs.org/oreis/help/oreishome.html
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Association
OSL	Optically Stimulated Luminescent (Dosimeter)
OU	Operable Unit
PACE	Paper, Allied-Industrial, Chemical, and Energy Workers Union
PAM	Perimeter Air Monitor
PCB	Polychlorinated Biphenol
pCi	$1x10^{-12}$ Curie (Picocurie)
PCM	Poplar Creek Mile (station location)
pH	Proportion of Hydrogen Ions (acid vs. base)
PWSID	Potable Water Supply Identification “number”
ppb	Parts per Billion
ppm	Parts per Million
ppt	Parts per Trillion
PRG	Preliminary Remediation Goals
QA	Quality Assurance
QC	Quality Control
R	Roentgen
RBP	Rapid Bioassessment Program
RCRA	Resource Conservation and Recovery Act

REM (rem)	Roentgen Equivalent Man (unit)
RER	Remediation Effectiveness Report
ROD	Record of Decision
RSE	Remedial Site Evaluation
SLF	Sanitary Landfill
SNS	Spallation Neutron Source
SOP	Standard Operating Procedure
SPOT	Sample Planning and Oversight Team (TDEC)
SS	Surface Spring
STP	Sewage Treatment Plant
SW	Surface Water
TDEC	Tennessee Department of Environment and Conservation
TDS	Total Dissolved Solids
TIE	Toxicity Identification Evaluation
TLD	Thermoluminescent Dosimeter
TOA	Tennessee Oversight Agreement
TRE	Toxicity Reduction Evaluation
TRM	Tennessee River Mile
TRU	Transuranic
TSCA	Toxic Substance Control Act
TSCAI	Toxic Substance Control Act Incinerator
TSS	Total Suspended Solids
TTHM's	Total Trihalomethanes
TVA	Tennessee Valley Authority
TWQC	Tennessee Water Quality Criteria
TWRA	Tennessee Wildlife Resources Agency
U.S.	United States
UT-Battelle	University of Tennessee-Battelle (ORNL Prime Contractor)
VOC	Volatile Organic Compound
WCK	White Oak Creek Kilometer (station location)
WM	Waste Management
WOL	White Oak Lake
X-####	Facility at X-10 (ORNL)
X-10	Oak Ridge National Laboratory
Y-####	Facility at Y-12
Y-12	Y-12 Plant (Area Office)

INTRODUCTION

The Tennessee Department of Environment and Conservation (TDEC), Department of Energy (DOE) Oversight Division (the division), under terms of the Tennessee Oversight Agreement Section A.7.2.1, is providing an annual environmental monitoring plan for the calendar year 2007. The plan consists of a series of individual work plans describing independent environmental monitoring and surveillance. Oversight of DOE's environmental monitoring and surveillance programs is also described. Chemical and radiological emissions in the air, water, biota, and sediment on the Oak Ridge Reservation and environs are emphasized. The goal is to assure that DOE's Oak Ridge Operations have no adverse impact to public health, safety, or the environment. Results from our monitoring and our findings of the quality and effectiveness of the DOE's environmental programs are reported in our quarterly and annual status reports. An annual environmental monitoring report is also provided each spring that details the technical results of these studies.

This plan offers the Department of Energy the opportunity to review and consult on the division's monitoring activities and to take split samples as needed. For situations such as storm events, non-permitted discharges, emergencies or spills, we may perform short-notice or no-notice sampling. DOE will be informed as soon as a decision is made to take short-notice or no-notice samples. Environmental monitoring is a dynamic process and will periodically change. Major changes to this plan will be made in writing to DOE.

The division or the Tennessee Department of Health, Environmental Laboratory and Microbiological Laboratory Organization (Laboratory Services) will process quantitative chemical samples. Laboratory Services has expertise in a broad scope of services and analyses. Certain analyses and quality assurance/quality control (QA/QC) samples are subcontracted out by Laboratory Services to independent certified laboratories. Bench level QA/QC records and chain-of-custody records are maintained by Laboratory Services for all samples collected by the division. The Laboratory Services Standard Operating Procedures are followed and also serve as a guide to the division's laboratory procedures. General sampling and analysis methods follow EPA guidelines.

Benthic macroinvertebrates and other biological samples are taxonomically identified at Laboratory Services, in the division's laboratory, or by Laboratory Services subcontractors. Common water quality measurements and radiological readings are done in the field with calibrated instruments. Environmental dosimeters and radon detectors are analyzed by outside vendors. All work follows EPA, state, and instrument manufacturer's protocols as appropriate. Data loggers are used to reduce transcription errors.

Air Quality Monitoring

The division's integrated air quality monitoring is designed to verify and enhance DOE monitoring of the air quality on the Oak Ridge Reservation and in surrounding areas which may be impacted from DOE Oak Ridge Operations. The division implements EPA's Environmental Radiation Ambient Monitoring System (ERAMS) Air Program. We provide radiological surveillance of ambient air quality in the vicinity of the ORR and compare the results to that of the national ERAMS program. A precipitation monitor has been added to the ERAMS system from which radiological contaminants in rain and snow will be assessed. The ORR perimeter program is oversighted. In fact, we have arranged to use DOE's pre-filter media for our own radiological analysis and direct trend comparisons. Portable samplers are also set up to measure hazardous and radioactive contaminants around DOE demolition and remediation projects. In 2005, we added EMWMF as an air-sampling site for fugitive emissions. Results are used to verify that DOE keeps contamination contained during cleanup and disposal activities. In the event of a large catastrophic release, any of these data could be used for consequence assessment and to guide recovery efforts, even in the community.

Biological Monitoring

The division provides independent biological monitoring and oversight on and off the Oak Ridge Reservation to determine the impact of DOE operations. We also work in conjunction with the Tennessee Wildlife Resources Agency (TWRA), the Tennessee Valley Authority (TVA), and with other Tennessee Department of Environment and Conservation offices to coordinate valley-wide monitoring efforts related to fishing advisories. Specific contaminant pathways are investigated on the Oak Ridge Reservation as well. Results are used to formulate recommendations on clean up and to measure potential human and/or environmental risk. We are currently measuring impacts to aquatic biota, contamination in geese, and other indicator species such as lichens and watercress. We are also mapping invasive plants on a 3000-acre conservation easement.

Drinking Water Monitoring

Public water systems on the Clinch and Tennessee Rivers can be adversely impacted by DOE activities on the Oak Ridge Reservation. Our independent drinking water monitoring supports the public water system's monitoring efforts related to releases from the Oak Ridge Reservation. The division implements EPA's Environmental Radiation Ambient Monitoring System (ERAMS) Drinking Water Program. Results are compared to the national program. We provide labor; EPA provides expendables and analysis. Because DOE plant water distribution systems operate at a fraction of historical capacity and can stagnate, we also monitor chlorine residuals in DOE facilities. The comprehensive goal is to document trends and ensure that systems continue to be safe from radiological, chemical, and bacteriological contamination.

Groundwater Monitoring

The division's groundwater monitoring program provides information about Oak Ridge Reservation releases and potential impacts on health and the environment. Given the implications of contaminant transport off the Oak Ridge Reservation via groundwater, the division will continue to emphasize the identification of groundwater pathways. This will be accomplished by monitoring water supplies, wells, and springs, both on and off the ORR and by conducting hydrogeological investigations such as aquifer evaluations and dye traces. Integration of groundwater and surface water sampling results allows us to refine concepts of groundwater behavior. Much groundwater tracing is opportunistic, as we must take advantage of favorable weather, or discoveries made during construction or remediation, etc. Citizen reports of large springs in the ORR environs are useful to us and guide our sample planning.

Radiological Monitoring

The division's radiological monitoring is directed toward the development of a comprehensive radiological monitoring system as prescribed by the Tennessee Oversight Agreement, Attachment C.2 *"Radiological Oversight."* The primary focus of the program is the detection of radiological contamination with the potential to impact human health and the environment. Our radiological program contributes in all media areas and reviews CERCLA, NEPA, waste disposition, and other projects involving radionuclides. Autonomous monitoring includes facility surveys, gamma monitoring of the ORR and UF_6 yards, footprint reduction surveys, surplus sales surveys, and real-time gamma monitoring around active demolition and remediation sites. Automated gamma monitoring is being done at the Environmental Management Waste Management Facility (EMWMF) in Bear Creek Valley, for example. The DOE weigh scales database is compared to our gamma-monitoring data. Using time stamps to match data, we are monitoring radiation readings on waste shipments delivered for disposal and assuring that radioactive shipments are weighed and documented.

Surface Water Monitoring

The division measures trends in the quality of water and sediments in the Clinch River and Oak Ridge Reservation tributaries. Surface water is one of Tennessee's most important economic and environmental

resources, but local waterways rarely unconditionally meet all designated uses. For example, there are advisories on fish consumption from local reservoirs and streams. Legacy pollution from DOE, other industries, and non-point source origins are continuing problems. Long term monitoring can define success or failure of clean-up actions, source controls, and attenuation. Specifically, we are analyzing water from Bear Creek to isolate legacy source inputs. It is hoped that the long-term monitoring strategy for the new Environmental Management Waste Management Facility can be positively affected and that existing sources/pathways can be found, analytically isolated, trended, and remedied.

From another perspective, the Clinch and Tennessee Rivers are drinking water sources for several municipalities. Knowing the pollutant concentration is vital to the monitoring of those drinking water sources. In 2007, monitoring and investigation will continue in closer proximities to remediation projects and new construction sites such as SNS. We are also doing a significant amount of storm-event-related sampling. This will provide a better resolution in evaluating the success of clean-up and remediation efforts.

Invitation for Public Comment

This plan is published to inform the public about state sampling on the ORR and environs. Any comments from the public on where or how our future sampling should be done are greatly appreciated. Comments can be sent to:

Darlene Seagraves
TDEC DOE-O
761 Emory Valley Road
Oak Ridge TN 37830

Comments can also be sent to darlene.seagraves@state.tn.us or faxed to (865) 482-1835.

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AIR QUALITY MONITORING

Monitoring of Hazardous Air Pollutants (HAPs) at the East Tennessee Technology Park (ETTP)

Introduction

This independent monitoring project is conducted under authority of the Tennessee Oversight Agreement. It is a continuation of the ambient air-monitoring project initiated in 1997 in response to the heightened level of public concern regarding potential impacts to public health from the Toxic Substance Control Act Incinerator (TSCAI) emissions. Additionally, with the continuation of decontamination and decommissioning (D&D) activities, further analyses of the potential impacts of these projects on the ambient air on and around the East Tennessee Technological Park (ETTP) site is warranted.

Through use of the division's hi-volume ambient air samplers, levels of arsenic, beryllium, cadmium, chromium, lead, nickel and uranium (as a metal only) in the ambient air at the ETTP site will be monitored. Possible sampling locations have been selected through wind rose data diagrams indicating the prevailing wind flow directions at the ETTP site. The sites are as follows:

- K-2 Blair Road across from the TSCA Incinerator,
- Station 42/TSCA-1 on Blair Road and,
- Station 35/TSCA-2 sites on Gallaher Road. (See Figure 1)

Currently, the monitor has been located at the K-2 site. The U.S. Department of Energy (DOE) maintains an air-monitoring sampler for metals and radiological emissions at this site. This location was selected on the basis of a wind rose plot diagram, as well as monitoring data collected by DOE. Although this project will sample for metals only, the Radiological Monitoring Oversight (RMO) program of the Tennessee Department of Environment (TDEC), Department of Energy Oversight Division (DOE-O, the division) will continue ongoing radiological ambient air monitoring on the ETTP site. A background monitor will be located in the Oak Ridge area outside of the region influenced by sources of air emissions at ETTP.

Methods and Materials

On a weekly basis, sample filters will be collected from the ETTP and background samplers. Composite samples will be analyzed quarterly by a sub-contractor of Laboratory Services in Nashville according to Environmental Protection Agency (EPA) Method IO-3.5, which determines what metals are present in ambient air particulate using inductively coupled plasma/mass spectrometry (ICP-MS). The composite sample will be made giving each filter equal weight. Filters collecting particulate from air volumes differing from the quarterly mean sample volume by more than 20 percent will be sent to the state lab for individual analyses.

The monitoring sampler will remain at the K-2 site, which is closest to the TSCA incinerator, unless changing conditions at the site alter monitoring priorities. However, the option of moving the sampler to one of the other locations listed above, or elsewhere around ETTP, is a possibility, should a need to do so be perceived by the staff.

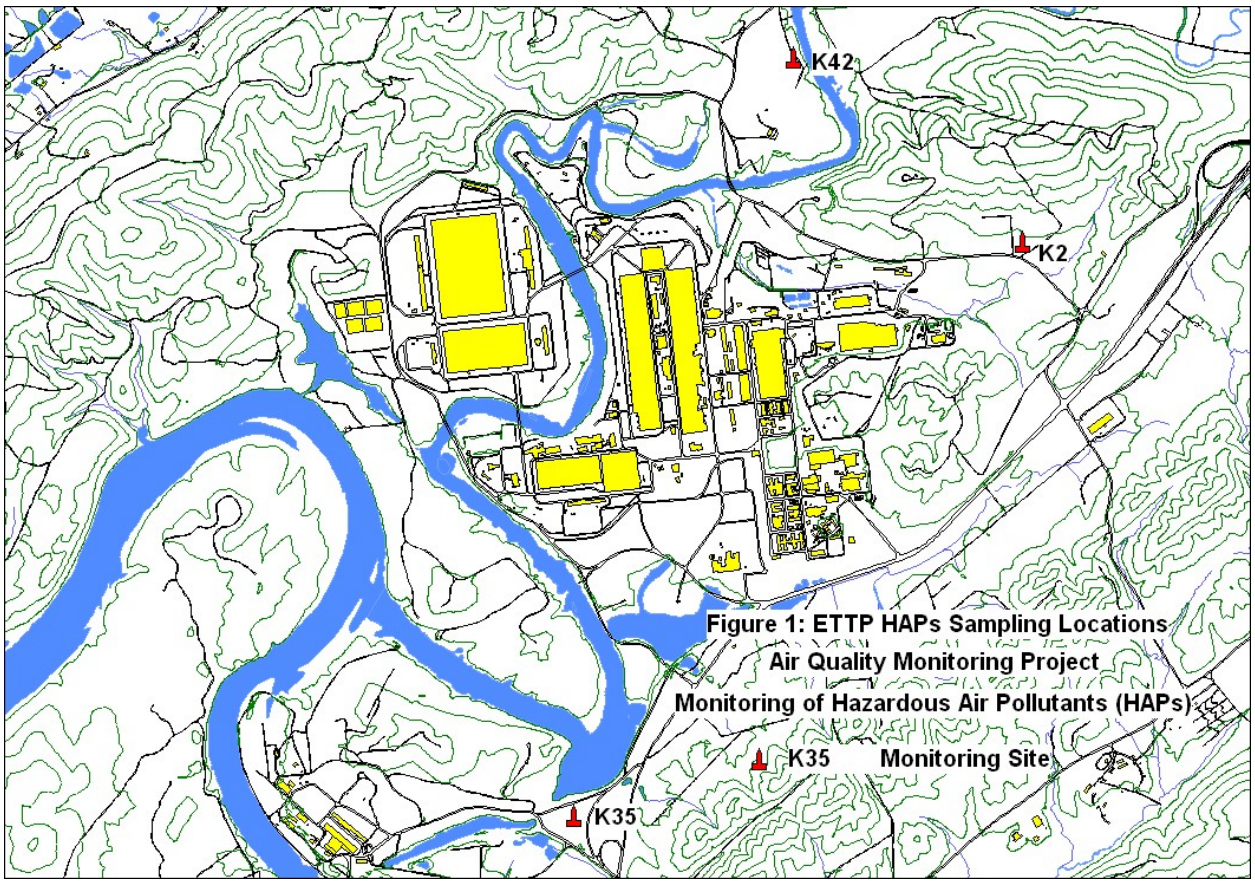

Figure 1: ETTP HAPs Sampling Locations

Methods and protocols have been developed based on equipment maintenance manuals supplied by the manufacturers and on sampling criteria tailored specifically to this project and DOE-O's mission and staffing levels (Thomasson, 2004 and other TDEC guidance). The sampler motor will be disassembled and the motor's brushes will be inspected for condition and evaluated for longevity at intervals of less than two months since the last brush change. When it is not expected that the brushes will last until the next site visit, they will be replaced. Based on experience with the typical lifetime of the sampler motor, it will be changed about twice annually.

The sampler will also be inspected to ensure that the orifice remains level and parallel to the ground. At each site visit the sampling cartridge will be removed and replaced with one holding a new filter. The cartridge will be covered both top and bottom, and the sample will be removed at the DOE-O laboratory and placed in a zip-lock bag.

The 24-hour chart recording pressure differential will be removed and replaced weekly and its pen trace will be evaluated for average readings for the weekly period. Relevant information will be recorded on the reverse side of the chart. Readings of atmospheric pressure and ambient temperature are to be recorded on the chart, and the reading of the elapsed time indicator will also be taken. Proper chain of custody for samples will be maintained. DOE-O staff will maintain an annual calibration check that will be carried out in accordance with the manufacturer's specifications.

Reporting will be done quarterly on the status of analytical results from each sampling location. Mean values will be compared with reference to air concentrations from Title 40 CFR 266. They will also be compared with sampling results from DOE monitors around the ETTP site. Conclusions regarding current levels of HAPs metals in ambient air will be prepared in an annual report and included in the DOE-O environmental monitoring report.

Materials required for this project include:

hi-volume sampler	filters
sampler replacement parts	calibration kit
level	flow charts
extension cords	waterproof marking pens
tool kit	project data/custody forms
motor brushes	plastic sample bags

References

Air Monitoring/Air Sampling Procedures, SOP-ES&H-004, Tennessee Department of Environment and Conservation, Department of Energy Oversight Division.

Boiler and Industrial Furnace Regulations, Title 40 CFR Part 266, Appendix V

Guidelines for the Control of Toxic Ambient Air Contaminants, *Appendix B of Air Guide-1, Ambient Air Quality Impact Screening Analyses*, Draft, New York State Department of Environment Control.1994 Edition.

Operations Manual for GMW Model2000H, Total Suspended Particulate Sampling System, Graseby GMW Variable Resistance Calibration Kit # G2835, 1998

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

Thomasson D.A., *Health, Safety and Security Plan*, Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee. 2004.

Monitoring of Hazardous Air Pollutants at Y-12

Introduction

This monitoring project is conducted under authority of the Tennessee Oversight Agreement. It is a continuation of the ambient air-monitoring project initiated in 1998 in response to the public's concern regarding possible health effects resulting from the potential presence of hazardous air pollutants (HAPs) on and around the Oak Ridge Reservation. This project presents an opportunity to independently evaluate the impact of uranium processing operations and remediation activities on ambient air at the Y-12 National Security Complex.

Through use of one of the division's hi-volume ambient air samplers, levels of arsenic, beryllium, cadmium, chromium, lead, nickel and uranium (as a metal only) in the ambient air at the Y-12 National Security Complex will be determined. The goal of this project will be accomplished by placing samplers at predetermined sampling locations currently in use. These locations were selected based on wind rose data, availability of electrical power, and co-location with DOE and TDEC radiological air monitors. The sites are as follows (see Figure 1):

Y-12E - ERAMS station east of the plant entrance
Y-12W - ERAMS station west of the plant site

Although this project will sample for metals only, the Radiological Monitoring Oversight (RMO) program of the Department of Energy Oversight Division (DOE-O) will continue ongoing radiological ambient air monitoring on the Oak Ridge Reservation. Metals results from the Y-12 plant will be compared to those obtained from HAPs monitoring at the East Tennessee Technology Park (ETTP) to aid in the detection of any impact on ambient air quality from the hazardous, toxic and radiological waste (TSCA) incinerator located there. Uranium results may be used to help check the results from RMO's uranium monitoring around Y12.

Methods and Materials

On a weekly basis, sample filters will be collected from the ETTP and background samplers. Composite samples will be analyzed quarterly by a sub-contractor of The Tennessee Department of Health's Environmental Laboratory Services and its Microbiological Laboratory Services Organization (Laboratory Services) in Nashville according to EPA Method IO-3.5. This method determines what metals are in ambient air particulate using inductively coupled plasma/mass spectrometry (ICP-MS). The composite sample will be made giving each filter equal weight. Filters collecting particulate from air volumes differing from the quarterly mean sample volume by more than 20 percent will be sent to the state lab for individual analyses.

Samplers will typically be located east of the site, which is generally in the direction of the maximum average wind speed. However, the samplers will remain on trailers and can be moved if desired.

Methods and protocols have been developed based on equipment maintenance manuals supplied by the manufacturers, and sampling criteria have been specifically tailored to this project and DOE-O's mission and staffing levels (Thomasson, 2004 and other TDEC guidance). The sampler motor will be disassembled and the motor's brushes inspected for condition and evaluated for longevity at

intervals less than two months since the last brush change. When it is not expected that the brushes will last until the next site visit, they will be replaced. Sampler motors will be replaced about every six months.

The sampler will also be inspected to ensure that the orifice remains level and parallel to the ground. At each site visit, the sampling cartridge will be removed and replaced with one holding a new filter. The cartridge will be covered both top and bottom, and the sample will be removed at DOE-O's laboratory and placed in a zip-lock bag. The 24-hour chart recording pressure differential will be removed and replaced weekly, and its pen trace will be evaluated for average readings for the weekly period. Relevant information will be recorded on the reverse side of the chart. Readings of atmospheric pressure and ambient temperature are to be recorded on the chart, and the reading of the elapsed time indicator will also be taken. Proper chain of custody for samples will be maintained. DOE-O staff will maintain an annual calibration check that will be carried out in accordance with the manufacturer's specifications.

Reporting on the status of analytical results from each sampling location will be done quarterly. Mean values will be compared with reference to air concentrations from Title 40 CFR 266. They will also be compared with results from DOE monitors around the ETTP site. Annually, a report will be prepared presenting conclusions regarding current levels of HAPs metals in ambient air and included in the DOE-O Environmental Monitoring Report.

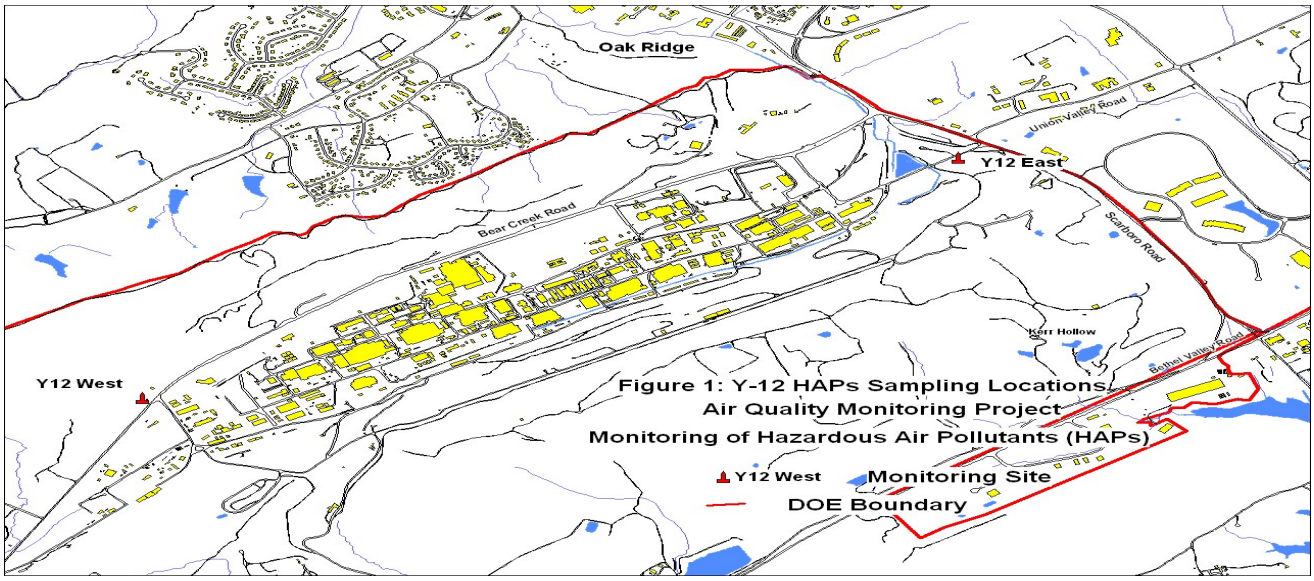

Figure 1 Y-12 HAPs Sampling Locations

Materials required for this project include:

hi-volume samples	filters	plastic sample bags
trailer	calibration kit	motor brushes
level	flow charts	
extension cords	waterproof marking pens	
tool kit	project data/custody forms	

References

Air Monitoring/Air Sampling Procedures, SOP-ES&H-004, Tennessee Department of Environment and Conservation, Department of Energy Oversight Division.

Boiler and Industrial Furnace Regulations, Title 40 CFR Part 266, Appendix V

Guidelines for the Control of Toxic Ambient Air Contaminants, Appendix B of Air Guide-1, Ambient Air Quality Impact Screening Analyses, Draft, New York State Department of Environment Control.1994 Edition.

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Thomasson, D.A., *Health, Safety and Security Plan,* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge. 2004.

RadNet Air Monitoring on the Oak Ridge Reservation

Introduction

In the past, air emissions, as a consequence of Department of Energy (DOE) activities on the Oak Ridge Reservation (ORR), have been believed to be a potential cause of illnesses affecting area residents. While these emissions have substantially decreased over the years with the decommissioning of various processes, concerns have remained that air emissions from current activities may pose a threat to the health of the public and/or the surrounding environment. As a consequence of the above, the Tennessee Department of Environment and Conservation, DOE Oversight Division (the division) will continue three air-monitoring programs developed to assess the impact of ORR air emissions on the surrounding environment and on the effectiveness of DOE controls and monitoring systems.

The division's Perimeter and Fugitive Air Monitoring Programs (described in associated plans) will focus on monitoring at exit pathways, diffuse emissions, and sites of special interest (e.g., remedial sites). The division participation in EPA's RadNet Air program will target specific operations (e.g., the High Flux Isotope Reactor & the TSCA Incinerator) and provide verification of state and DOE monitoring, via independent third party analysis.

Methods and Materials

The five RadNet air monitors will use synthetic fiber filters (ten centimeters in diameter) to collect particulates as air is pulled through the units at approximately 35 cubic feet per minute. The monitors will be operated continuously and the filters will be changed twice weekly (Monday and Thursday) by division staff. As prescribed in *Environmental Radiation Ambient Monitoring System (ERAMS) Manual* (U.S. EPA, 1988), the quantity of radioactivity on each filter will be estimated by staff, using one of the division's Geiger-Mueller radiation detectors. The filters will then be mailed to EPA's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama for analysis. The results received from NAREL will be compared to data collected in the perimeter and fugitive air monitoring programs (to verify the quality of state analysis) and to the Clean Air Act (to assess compliance with applicable standards).

Analytical parameters and frequencies for the RadNet Air Monitoring Program are provided in Table 1.

Table 1: EPA Analysis of Air Samples Taken in Association with the RadNet Program

ANALYSIS	FREQUENCY
Gross Beta	Each of twice weekly samples
Gamma Scan	Samples having > 1 pCi/m^3 of gross beta
Plutonium-238, Plutonium-239, Plutonium-240, Uranium-234, Uranium-235, Uranium-238	Semiannually on composite air particulate filters

The approximate locations of the five RadNet air-monitoring stations are depicted in Figure 1.

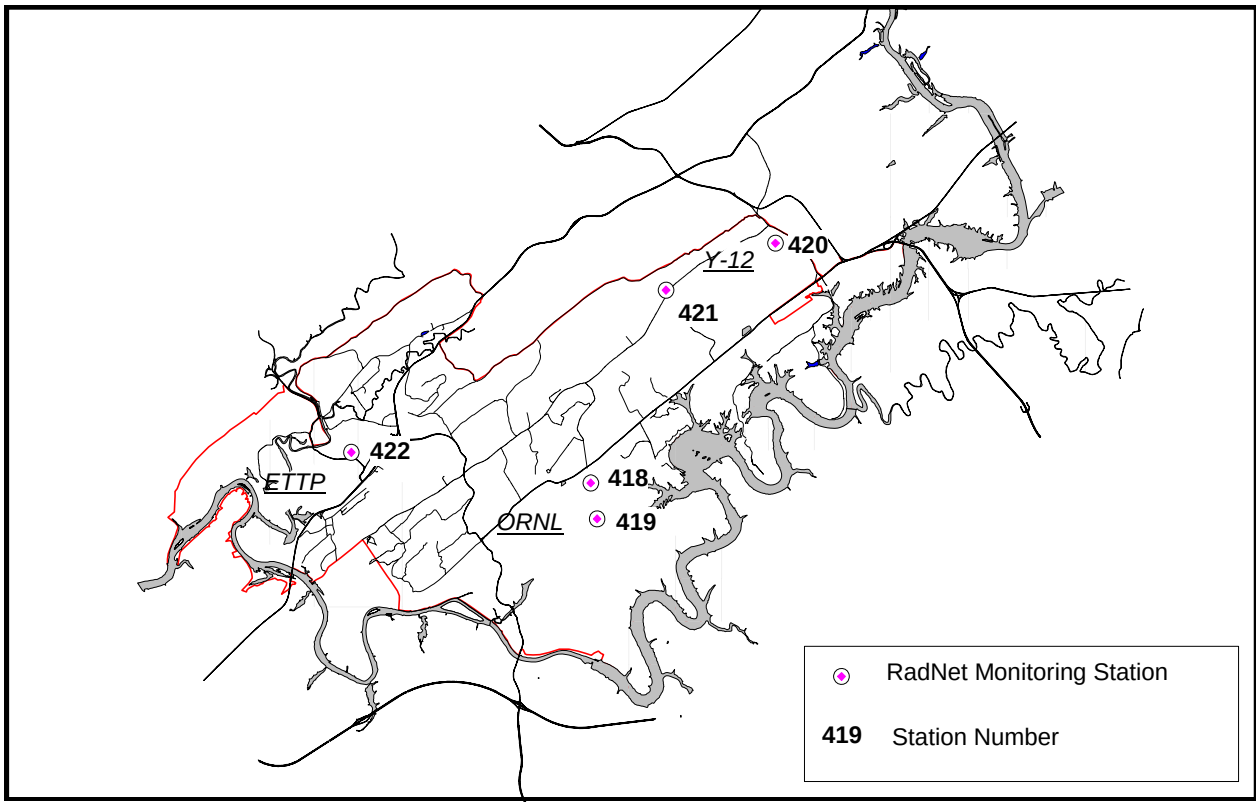

Figure 1: Approximate Locations of Air Stations Monitored in Association with EPA's RadNet Air Program on the Oak Ridge Reservation

References

Environmental Radiation Ambient Monitoring System (ERAMS) Manual, EPA520/5-84-007, 008, 009, Environmental Protection Agency, May 1988.

Environmental Radiation Data Report 80, EPA-402-R-97-004, U.S. Environmental Protection Agency, 1994 data, published February 1997.

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http://www.epa.gov/narel/radnet/programs.html#air. U.S. Environmental Protection Agency, 2006a, (Last updated March 5, 2006).

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Thomasson, D.A., *Health, Safety, and Security Plan*, Tennessee Department of Environment and Conservation, DOE-Oversight Division. Oak Ridge, Tennessee. 2004.

Monitoring Fugitive Radioactive Air Emission on the Oak Ridge Reservation

Introduction

In 2007, the Tennessee Department of Environment and Conservation DOE Oversight Division (the division), with the cooperation of the Department of Energy (DOE) and its contractors, will continue monitoring for fugitive radioactive air emissions on and in the vicinity of the Oak Ridge Reservation. This program uses mobile high-volume air samplers to supplement air monitoring performed at fixed locations. In this respect, the high-volume monitors, along with more frequent sampling and analysis, provide greater measurement sensitivity and resolution than can be achieved with the low-volume monitors used in the division's Perimeter Air Program. Monitoring performed with the mobile units will primarily focus on nonpoint sources of air emissions and sites of special interest.

Methods and Materials

The division will deploy five high-volume air monitors in the program in 2007. One of the monitors will be stationed at Fort Loudoun Dam in Loudon County to collect background data. The other units will be placed at locations where there appears to be a potential for the release of fugitive/diffuse emissions. Two of the samplers are currently positioned to monitor the demolition of the K-25 Process Building and the K-1420 Decontamination Facility, both located at ETTP. The third unit has been placed to monitor waste disposal activities at the Environmental Management Waste Management Facility in Bear Creek Valley. The fourth unit is located at the Oak Ridge National Laboratory (ORNL) near the Corehole 8 remediation site to monitor the excavation of contaminated soils. Other locations being considered for monitoring include facilities being renovated under the revitalization initiative at ORNL and buildings being demolished at Y-12 as part of its infrastructure reduction program.

The high-volume monitors will use 8x10 inch glass fiber filters to collect particulates as air is pulled through the system at a rate of approximately 35 cubic feet per minute. The filters will be collected weekly and shipped to Laboratory Services in Nashville, Tennessee, for analysis. As in the past, airflow through the filters will be calibrated quarterly, using a Graseby General Metal Works Variable Resistance Calibration Kit (#G2835).

Analytical parameters will include gross alpha, gross beta, and gamma spectrometry. The results will be compared to background values to determine if releases are occurring. Since the Clean Air Act (CAA) does not provide limits for gross activities, radionuclide specific analysis will be performed where the gross results indicate significant spikes, upward trends, consistently elevated results, and/or exceeded screening levels. The screening levels for gross measurements will be based on CAA limits for uranium-235 for alpha emitters (9.9E-15 uCi/ml above background) and strontium-90 for beta emitters (40.9 E-15 uCi/ml above background). Any gross measurements exceeding these criteria will require isotopic analysis to identify the major radionuclides present in the sample and each radionuclide's concentration. These concentrations will then be used to reassess compliance with the CAA.

References

National Emissions Standards for Hazardous Air Pollutants (NESHAPS), Clean Air Act, Title 40 CFR Part 61, Subpart H. U.S. Environmental Protection Agency, 1994.

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

Thomasson, D.A. *Health, Safety, and Security Plan.* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee. 2004.

Ambient VOC Monitoring of Air on the Oak Ridge Reservation

Project Description

The objective of this monitoring program is to perform ambient monitoring of air for volatile organic compounds (VOCs) at selected locations on the Oak Ridge Reservation (ORR). This will help determine the effects of activities and practices on the ORR using methods outlined in the *Photoionization Detector (PID) HNU Standard Operating Procedure (SOP) #2114* (October 1994).

Introduction

Ambient air monitoring will be conducted at several ORR locations using a photoionization detector (PID) with data logging capabilities. The division conducts several periodic air sampling efforts on the ORR. However, ambient VOC monitoring has not been attempted until now. Areas to be monitored will be Bear Creek Valley, Mitchell Branch, and Union Valley east of Y-12. All work associated with this program will be in compliance with the division's *Health, Safety, and Security Plan.*

Methods and Materials

Ambient air monitoring will be accomplished using the PID mounted in a suitable casing. Measures will be taken to secure the apparatus in the vicinity to be monitored. The casing will be a metal container ranging in size from that of a large mailbox to that of a galvanized metal trashcan. The detector will be suspended in such a way as to limit the amount of liquid that may enter the enclosure from rainfall and to maximize the amount of air to be monitored. A small pipe/rod will be placed through the sides of the container and the detector will be secured to it with a holder and a positive quick release mechanism.

The unit will consist of a Photovac 2020ProPlus PID using factory-supplied humidity filters placed in a filter holder. These filters regulate the amount of humidity entering into the ionization chamber to minimize the effects of water and to more accurately measure the total VOCs in the air. The units will be powered by an internal battery and a supplemental 12-volt automotive battery using a factory supplied 12-volt power charger cable and plug.

The PID enclosure will be mounted on a support sturdy enough to remain upright through normal to heavy weather. The automotive/marine battery will be housed in a weather tight box with the power cable leading to the PID.

Once the apparatus is emplaced at a location, it will be left to collect data using the data logging capability of the PID in intervals of one minute. The apparatus will be deployed for approximately one-week intervals. In order to facilitate collection of data, the intervals will start on Wednesday with the unit being checked and data being downloaded on Monday and the following Wednesday. At this point the apparatus will be retrieved and the data downloaded from the PID. The apparatus will then be redeployed at another location. Prior to deploying the apparatus in areas of suspected VOCs, a background location will be determined where data will be collected for comparison to data collected at the suspected areas of VOCs.

As the sites listed below are all associated with water, VOC samples will be collected in concert with the deployment of the unit. For the first few deployments, samples will be taken at deployment, mid-week and when the unit is collected. This is for a control and to be used as a reference to what is being measured. Water samples will be collected at an upstream, and as close as possible, location.

Response factors (RFs) can be used for determining the amount of specific gases if their presence is known. The manufacturer of the unit has published the RFs for this unit and they are available. Calibration gases for specific compounds can be prepared using procedures developed by the Chemical and Analytical Sciences Division of the Oak Ridge National Laboratory. If necessary these methods will be used to devise standards.

Schedule and sampling locations in kilometers (mile equivalents):

Bear Creek: BCK 9.6 (6.0).
JES Seep
Mitchell Branch: MIK 0.71 (0.44).
Cattail Spring:
Lila's Leak: P-3 Pond ETTP
J. A. Jones Spring: ETTP
SW-31: ETTP

All sites will be sampled twice each quarter.

References

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Methods TO-14A, Center for Environmental Research Information, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio. 1999.

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Method TO-15, Center for Environmental Research Information, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.1999.

Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region IV, 960 College Station Road, Athens, Georgia. 2001.

Method 8265 Direct Sampling Ion Trap Mass Spectrometry (DSITMS) Rapid Analytical Methods for Measuring Thirty-Four Organic Compounds on the EPA Target Compound List (TCL) in Water, Soil and Air, U.S. Department of Energy, Oak Ridge National Laboratory, Chemical and Analytical Sciences Division, Oak Ridge, Tennessee. November 1996.

Photoionization Detector (PID) HNU Standard Operating Procedure (SOP) #2114, U.S. Environmental Protection Agency, October 1994.

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

Thomasson, D. A., *Health, Safety, and Security Plan.* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee. 2004.

Perimeter Air Monitoring on the Oak Ridge Reservation

Introduction

The Tennessee Department of Environment and Conservation, DOE Oversight Division (the division), with the cooperation of DOE, will provide radiochemical analysis of air samples taken from twelve low-volume air monitors placed at locations believed to be the most likely pathways for airborne contaminants migrating off the Oak Ridge Reservation (ORR). Data derived from the analyses, along with information generated by the other division air monitoring programs, will be used to:

1) assess the impact of DOE activities on the public health and environment,
2) identify and characterize unplanned releases,
3) establish trends in air quality, and
4) to verify data generated by DOE and its contractors.

Methods and Materials

The twelve air monitors that will be used in the program are owned by DOE and, DOE contractors are responsible for their maintenance and calibration. Nine of the units are components of DOE's ORR perimeter air monitoring system. The remaining three monitors were previously used by the Y-12 complex in their perimeter air monitoring program.

Each of the monitors use forty-seven millimeter borosilicate glass fiber filters to collect particulates as air is pulled through the units. The ORR perimeter monitors employ a pump-and-flow controller to maintain airflow through the filters at approximately two standard cubic feet per minute. The Y-12 monitors control airflow with a pump-and-rotometer set to average approximately two standard cubic feet per minute.

Air filters from the monitors will be collected bi-weekly and sent by UPS to Laboratory Services in Nashville, Tennessee for analyses. Analysis will include gross alpha and gross beta on the biweekly samples and gamma spectrometry on an annual composite sample from each location. The results will be compared to the background data to determine if releases appear to be occurring and to the environmental standards provided in the Clean Air Act (Appendix E Table 2 of Title 40 CFR 61) to assess if any releases are likely to have exceeded the Clean Air Act dose limit for members of the public (10 mrem/year).

If the preliminary evaluation suggests that there is a potential for an unpermitted source, exceedence of Clean Air Act Standards, and/or practice inconsistent with the ALARA (As Low As Reasonably Achievable) principle, additional analyses will be performed on the samples to identify the specific radionuclides contributing to the release. The compliance status will also be reevaluated based on the radionuclide specific data. In all cases, the goal will be to maintain releases of radioactive contaminants as low as reasonably achievable (ALARA).

The twelve air monitoring stations in the program are listed in Table 1 and their locations are depicted in Figure 1. Eleven of these stations are located around the perimeter of the ORR and the Y-12 facility. The twelfth site is a background station located near Fort Loudoun Dam in Loudon County.

Table 1: Perimeter Air Monitoring Stations

Station	Location	County
4	Y-12 Perimeter near Portal 2	Anderson
5	Y-12 Perimeter near Building 9212	Anderson
8	Y-12 Perimeter west end	Anderson
35	East Tennessee Technology Park	Roane
37	Bear Creek at Y-12	Roane
38	Westwood Community	Roane
39	Cesium Fields at Oak Ridge National Laboratory Services	Roane
40	Y-12 East	Anderson
42	East Tennessee Technology Park off Blair Road	Roane
46	Scarboro Community	Anderson
48	Deer Check Station on Bethel Valley Road	Anderson
52	Fort Loudoun Dam (Background Station)	Loudon

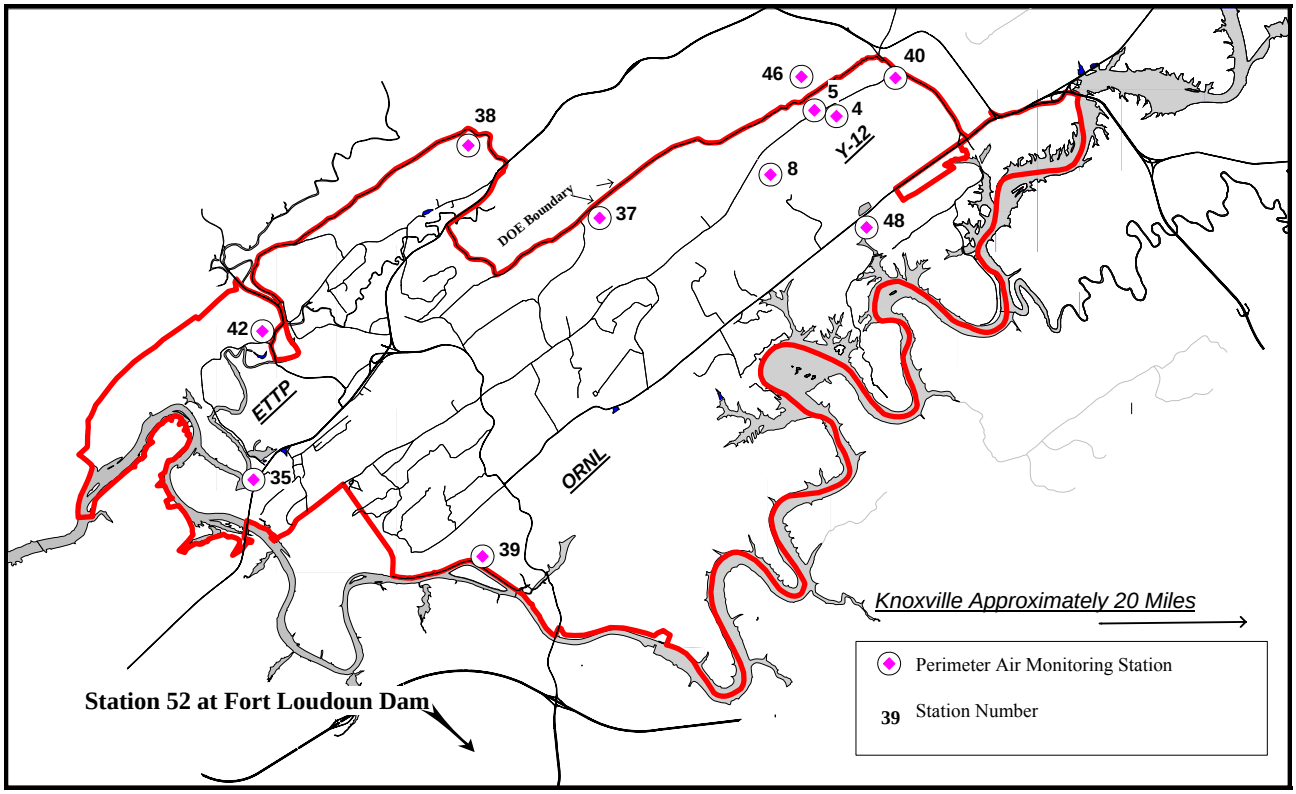


Figure 1: Approximate Location of Oak Ridge Reservation and Y-12 Perimeter Air Monitoring Stations

References

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

Thomasson, D.A. *Health, Safety, and Security Plan*. Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee. 2004.

RadNet Precipitation Monitoring on the Oak Ridge Reservation

Introduction

Precipitation monitoring was added to the RadNet program on the Oak Ridge Reservation in 2005. The project measures radioactive contaminants that are washed out of the atmosphere and carried to the earth's surface by precipitation. There are no standards that apply directly to contaminants in precipitation, but the data provide an indication of the presence of radioactive materials that may not be evident in the particulate samples collected by the division's air monitors. EPA has provided only one sampler, to date, but additional units may be manufactured by division staff, if warranted. Sites under consideration for precipitation monitoring include the TSCA Incinerator and an off-site location as yet undetermined.

One of the radioactive contaminants of concern in the atmosphere above the reservation is tritium. Small amounts of this radionuclide are produced naturally, but the isotope is also released as water vapor in reactor effluents and from evapotransporation associated with buried wastes. In light of the above, the precipitation monitor provided by EPA was placed at an existing RadNet station near ORNL's High Flux Isotope Reactor/SWSA (solid waste storage area) #5 Burial Grounds (the major source area for tritium on the reservation). Data received to date have been among the higher values reported for the RadNet monitoring stations across the nation (Figure 1). It should be noted, however, that Oak Ridge was the only station located near nuclear sources at the time. It is planned to leave the RadNet precipitation monitor at its current location.

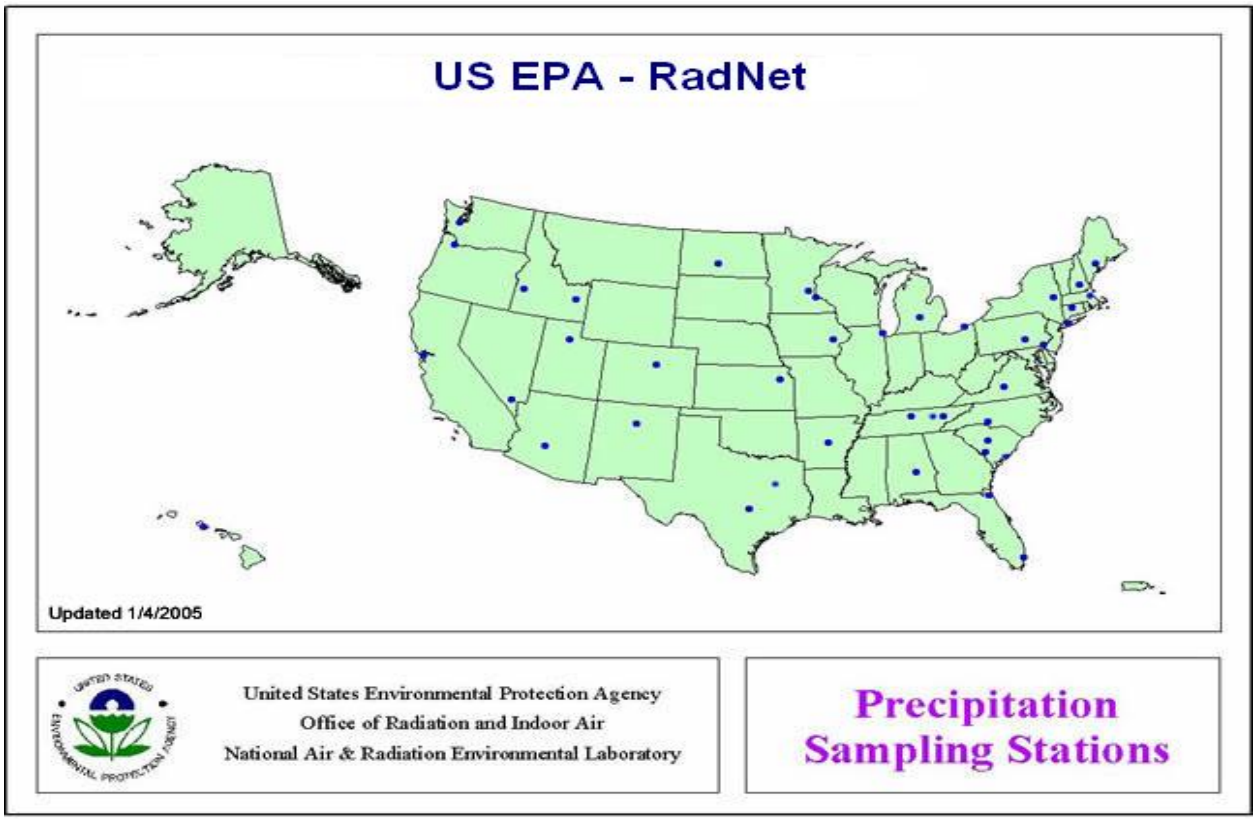


Figure 1: EPA RadNet Precipitation Monitoring Stations

Methods and Materials

The precipitation sampler provided by EPA's RadNet Program will be used to collect samples for the program. The sampler will drain precipitation that falls on a 0.5 square meter fiberglass collector into a five-gallon plastic collection bucket. A sample will be taken from the bucket (using a four-liter cubitainer) when a minimum of two liters of precipitation has accumulated in the container. The sample will then be processed as specified in *Environmental Radiation Ambient Monitoring System (ERAMS) Manual* (U.S. EPA, 1988) and shipped to EPA's National Air and Radiation Environmental Laboratory in Montgomery, Alabama for analysis (Table 1). When the analysis has been completed, the results will be provided to the division and posted on EPA's RadNet website (http://www.epa.gov/enviro/html/erams). The data will be used to identify anomalies (e.g., unknown contaminants), to assess the significance of precipitation in contaminant pathways, to evaluate associated control measures, and to appraise conditions on the Oak Ridge Reservation compared to other locations in the RadNet program.

Table 1: EPA Analysis of Precipitation Samples Taken in Association with the RadNet Program

ANALYSIS	FREQUENCY
Gross Beta	Monthly from composite samples
Gamma Scan	Monthly composite samples having > 1 pCi/m^3 of gross beta
Tritium	Monthly from composite samples

References

Environmental Radiation Ambient Monitoring System (ERAMS) Manual, EPA 520/5-84-007, 008, 009, U.S. Environmental Protection Agency, May, 1988.

Environmental Radiation Data Report 80, EPA-402-R-97-004, U.S. Environmental Protection Agency, 1994 data, published 1997.

http://oaspub.epa.gov/enviro/erams_query.simple_query, U.S. Environmental Protection Agency. 2006.

http://www.epa.gov/narel/radnet/programs.html#precip, U.S. Environmental Protection Agency, 2006. (Last updated March 5, 2006).

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation. Oak Ridge, Tennessee. 2006.

Thomasson, D.A. *Health, Safety, and Security Plan,* Tennessee Department of Environment and Conservation, DOE-Oversight Division. Oak Ridge, Tennessee. 2004.

BIOLOGICAL MONITORING

Fish Tissue Monitoring

Introduction

The Tennessee Department of Environment and Conservation (TDEC) posts warning signs around streams and lakes where public health is endangered. In Tennessee, the most common reason for a river or lake to be posted is the when the presence of contaminants (e.g. sewage and/or metals) is noted in the water, sediment, or fish of a water body.

When fish tissue samples show levels of a contaminant higher than established criteria, the water body is posted and the public is advised of the danger. If needed, Tennessee Wildlife Resources Agency (TWRA) can enforce a fishing ban. Approximately 84,100 lake acres and 142 river miles across the state are currently posted due to contaminated fish. When the department issues new advisories, signs are placed at significant public access points and a press release is submitted to local newspapers. Table 1 shows current criteria used for issuing fish consumption advisories in Tennessee.

Table 1: State of Tennessee Fish Tissue Advisory Criteria

Contaminant	Level (ppm)
PCBs	1.00
Hg	0.50

The annual fish tissue meeting is held each year to exchange data and coordinate sampling efforts among the many organizations that sample fish tissue in Tennessee. The 2006 meeting focused primarily on efforts around the Oak Ridge Reservation (ORR). Review of PCB levels in catfish on Watts Bar Reservoir indicates that these levels have continued to decline over the past several years. Table 2 shows current posting on Watts Bar Reservoir. None of the collecting agencies currently have funds available to analyze samples of species other than largemouth bass and channel catfish. This will be a multi-agency effort with the Tennessee Valley Authority (TVA) and Oak Ridge National Laboratory (ORNL) conducting the sampling, TDEC DOE-Oversight conducting the analysis, and TDEC Division of Water Pollution Control (WPC) evaluating the results.

Table 2: Current Fish Advisory Postings on Watts Bar Reservoir

Reservoir	Portion	Pollutant	Species
Watts Bar	TN River arm	PCBs	Catfish, striped bass, & hybrid (striped bass-white bass) should not be eaten. Precautionary advisory for white bass, sauger, carp, smallmouth buffalo, and largemouth bass.
Watts Bar	Clinch River arm	PCBs	Striped bass should not be eaten. Precautionary advisory for catfish and sauger.

Methods and Materials

Fish samples will be collected by various agencies during the course of their normal collection activities. Table 3 lists species that will be collected and the sites from which they will be collected. Preparation of samples will be done by the collecting agency with TDEC DOE-O samples being submitted to Laboratory Services for analysis. Samples will consist of a homogenized five-fish composite for each site and species. Analyses for PCBs and mercury will be conducted on each sample. In situations where five fish cannot be collected from a location, a minimum of a three-fish composite will be used if possible. Based on this collection, there will be a total of 10 samples submitted for PCB and mercury analysis. Collection will take place during Fall 2007.

Table 3: Watts Bar Reservoir Fish Tissue Collections

Site	**Location**	**Species to be Collected**							
Forebay	TRM 531	Channel Catfish	LMB	Sauger	Small Buffalo	Striped Bass	Hybrid Bass	White Bass	Carp
Mid-Res	TRM 560.8	Channel Catfish	LMB	Sauger	Small Buffalo	Striped Bass	Hybrid Bass	White Bass	Carp
TN Inflow	TRM 600	Channel Catfish	LMB	Sauger	Small Buffalo	Striped Bass	Hybrid Bass	White Bass	Carp
CL Inflow	CRM 19	Channel Catfish	LMB	Sauger		Striped Bass			

LMB = Largemouth Bass

Hybrid bass = Striped Bass-White Bass Hybrid

References

Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1: Fish Sampling and Analysis. Third Edition. EPA 823-B-00-007, U.S. Environmental Protection Agency, Office of Water, Washington, DC, 2000.

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation. Oak Ridge, Tennessee. 2006.

Thomasson, D. A. *Health, Safety, and Security Plan.* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee. 2004.

Benthic Macroinvertebrate Monitoring

Project Description

The objective of this monitoring program is to perform biological monitoring on streams affected by activities and practices on the Oak Ridge Reservation (ORR). Methods outlined in the *State of Tennessee Department of Environment and Conservation (TDEC), Division of Water Pollution Control (WPC) Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys* (March 2002, Revised November 2003) will be used.

Introduction

Because benthic macroinvertebrates are relatively sedentary and long-lived, they are excellent indicators of the "overall health" of an aquatic system. In systems where the source of the toxicant is non-point (e.g. runoff or seeps) or where the combined effects of pollutants in a complex effluent exceed individual toxicity (synergism), benthic macroinvertebrate communities may be one of the only means of evaluation.

Benthic macroinvertebrates are collected from various ORR streams and analyzed to independently assess the "overall health" of the aquatic environments and to measure the degree of impact from past and present DOE operations. The division conducts annual semi-quantitative biomonitoring on the following ORR streams: Bear Creek, Mitchell Branch, White Oak Creek, Melton Branch, and East Fork Poplar Creek. Benthic samples are also collected from Clear Creek near Norris Dam to serve as an ecoregion reference site for all ORR test sites. Three sites will be sampled for qualitative purposes at no cost. These sites are Ernie's Creek, Upper Scarboro Creek near the UT Arboretum, and Lower Scarboro Creek.

Surface water samples will be collected semi-annually at all semi-quantitative sites and will compliment the macroinvertebrate sampling. Water samples will be transported to Laboratory Services in Knoxville and analyzed for bacteria, nitrates, hardness, metals, mercury, and radionuclide constituents. Sulfates will also be analyzed in East Fork Poplar Creek, Hinds Creek, and Clear Creek. EPA-approved methods will be used for the collection of the water samples. All work associated with this program will be in compliance with the division's *Health, Safety, and Security Plan.*

Methods and Materials

Benthic macroinvertebrate samples will be collected and processed following TDEC Water Pollution Control (WPC) standard operating procedures (SOP). The semi-quantitative Riffle Kick (SQKICK) collection technique for single habitat analysis will be used. This test method involves standing in a body of water, kicking up sediment and catching the suspended organisms in a kick net. A riffle kick is done in relatively fast-moving water and a run kick in slower-moving water. Another test is the undercut bank jab, done by sampling the sediment below water level in an area that is overhung by brush.

Samples will be collected from two riffles at each site. Both samples will be combined and transferred into one sample container. The container will be labeled internally and externally with site-specific information and stored in the TDEC DOE-O laboratory for future processing. Standard methods will be altered when sampling lower White Oak Creek due to the presence of radioactive

contamination in the stream sediment. The two kick samples will be combined in a five-gallon bucket, creek water will be added and the sample swirled to suspend the lighter material (invertebrates), which will then be poured through a sieve. This process will be repeated five times, collecting the majority of organisms. Any material not used will be returned to the creek.

Once collections have been made at all sites, the semi-quantitative samples will be transported to Laboratory Services in Nashville for processing. Laboratory Services sample analyses will include the identification and enumeration of the benthic macroinvertebrates. Using the raw benthic data from the semi-quantitative sub-samples, a numerical value will be generated for seven biometrics. These metrics include (1) EPT (Ephemeroptera, Plecoptera, and Trichoptera) richness, (2) taxa richness, (3) percent OC (oligochaetes and chironomids), (4) percent EPT (EPT abundance), (5) NCBI (North Carolina Biotic Index), (6) percent nutrient tolerant, and (7) percent clingers (contribution of organisms that build fixed retreats or that have adapted to attach to surfaces in flowing waters). After values have been calculated for the metrics, a score of 0, 2, 4, or 6 is assigned to each metric based on comparison to the ecoregion reference database. The seven scores are totaled and the site's biological condition is determined. Metric equations and the biocriteria used to determine biological condition can be obtained by referring to the TDEC WPC SOP.

Sampling Locations in Kilometers (mile equivalents) for RBP III Semi-Quantitative Sites:

East Fork Poplar Creek: EFK 25.1 (15.6), EFK 24.4 (15.2), EFK 23.4 (14.5), EFK 13.8 (8.6), and EFK 6.3 (3.9). Reference site: Hinds Creek HCK 20.6 (12.8).
Bear Creek: BCK 12.3 (7.6) and BCK 9.6 (6.0). Reference site: Mill Branch MBK 1.6 (1.0).
Mitchell Branch Creek: MIK 0.71 (0.44) and MIK 0.45 (0.28). Reference sites: MIK 1.43 (0.89).
White Oak Creek: WCK 2.3 (1.4), WCK 3.4 (2.1), and WCK 3.9 (2.4). Reference site: WCK 6.8 (4.2).
Melton Branch: MEK 0.3 (0.2)
Clear Creek: CCK 1.45 (ecoregion reference site).

All sites will be sampled within a three-day time span in April or May.

The three qualitative samples will be collected using the Biorecon (reconnaissance/screening) method. One to four productive habitats (e.g., riffles, runs, pools, and undercut banks) will be selected that comprise greater than 5% of the stable habitat in the sampling reach. The selected habitats will be divided into four portions based on percent contribution. For example, if the habitats consist of 50% riffle, 25% run, and 25% undercut bank, the sample would be comprised of two riffle kicks, one run kick, and one undercut bank jab. The four sub-samples will be combined into one site sample. Each habitat will be sampled over a 0.5-meter sampling area using a triangular net. The combined sample will be examined in the DOE-O Laboratory Services and appropriate information will be recorded on the Biorecon sheet. Using the raw benthic data, a numerical value will be generated for three qualitative biometrics: (1) EPT richness, (2) taxa richness, and (3) intolerant taxa (those organisms having NCBI values between 0.00 and 3.00). After values have been calculated for the metrics, a score of 1, 3, or 5 is assigned to each metric based on ranges at the scientific family level. The three scores are totaled and the site assessment is determined. The biocriteria used to determine biological condition can be obtained by referring to the TDEC WPC SOP.

Table 1: List of Analytes for Surface Water Samples

E. Coli	Arsenic
Enterrococcus	Cadmium
Nitrogen, NO_2, NO_3, & ammonia	Chromium
Total Kjeldahl nitrogen	Copper
Total phosphorus	Iron
Dissolved residue	Lead
Suspended residue	Manganese
Hardness, total, as $CaCO_3$	Zinc
Sulfates (East Fork Poplar Creek)	gross alpha & beta
Mercury	Gamma Spec

References

Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region IV, 960 College Station Road, Athens, Georgia. 1996.

Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Tennessee Department of Environment and Conservation, Division of Water Pollution Control, March 2002, Revised November 2003.

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

Thomasson, D.A. *Health, Safety, and Security Plan.* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee. 2004.

Diatom (Periphyton) Environmental Monitoring

Project Description

The goal of this monitoring program is to assess impacts of anthropogenic stress on benthic algae and diatoms (periphyton) in streams affected by activities and practices on the Oak Ridge Reservation (ORR). The investigation and determination of baseline diatom taxa as bioindicators of stream recovery will form the foundation of the project. Methodology for the project will follow periphyton survey protocols (ecoregion approach) as outlined in the State of Tennessee Department of Environment and Conservation (TDEC) Division of Water Pollution Control (WPC) *Regional Characterization of Streams in Tennessee with Emphasis on Diurnal Dissolved Oxygen, Nutrients, Habitat, Geomorphology and Macroinvertebrates* (Arnwine et al. 2005). Additional periphyton sampling and Laboratory Services protocols developed by Porter et al. (1993), Barbour et al. (1999) and Peck et al. (1999) will be used. During 2007, periphyton samples will be collected quarterly from artificial substrates in three ORR watersheds (see Maps 1-2). The main objectives of the project include: (1) to determine diatom composition and abundance of the periphyton community in each affected ORR watershed, (2) to establish a baseline of diatom taxa for the ORR, (3) to investigate longitudinal variation in diatom community structure to distance from pollution source, and (4) to support the division's comprehensive and integrated monitoring programs including concurrent macroinvertebrate monitoring.

Introduction

The Tennessee Department of Environment and Conservation, Department of Energy Oversight Division (TDEC-DOE-O), Environmental Monitoring and Compliance Section (EMC) will continue efforts to characterize diatom assemblages in order to assess the water quality of watershed streams on the Oak Ridge Reservation (ORR). Benthic algae (i.e., periphyton and diatoms) respond rapidly and sometimes predictably to a wide range of pollutants and provide potentially useful early warning signals of deteriorating water quality conditions. Because of their position at the base of aquatic food webs, algal indicators provide unique data concerning lotic (still water) and lentic (flowing water) aquatic ecosystem health. Diatoms are routinely used to assess water quality, and the literature suggests that they are excellent biological indicators for many types of pollution in aquatic systems (Lowe 1974, Patrick & Palavage 1994, and Kelly et al. 1995).

Periphyton is a complex matrix of mostly benthic algae (including diatoms), heterotrophic microbes, bacteria, fungi, and protozoa attached to submerged substrates in almost all aquatic ecosystems. Periphyton is an important primary producer in the food web and an important food source for invertebrates and some fish (i.e., stonerollers), and can be a collector of contaminants (DOE 2001). Diatoms, a major component of periphyton, are unicellular microflora (photosynthetic protists with chloroplasts) and belong to the phylum Chrysophyta (sub-phylum Bacillariophyceae). Diatoms colonize nearly every available aquatic habitat and are unique in that they have siliceous cell walls, or valves, that are held together by connecting bands (cingulum) called girdle bands. These valves form a silicified and overlapping frustule (shell) that fit together similar to a petri dish. The cell wall structure, ornamentation, size, and shape are the main diagnostic characters for taxonomic keying of diatom taxa (Stoermer and Smol 1999).

Diatom communities are sensitive bioindicators to a host of environmental variables that change along a stream's longitudinal gradient. Physiochemical conditions constitute a general productivity

gradient from upstream to downstream habitats, which influences ecological succession and produces later successional communities at downstream sites (Medley & Clements 1998).

Pollution (anthropogenic stress) of an aquatic system comes in many forms including organic and inorganic chemical, heavy metal, radiological contamination, microbiological, and those of a physical nature such as temperature, light, turbidity, and dissolved oxygen. Sources of pollution include industrial releases, agricultural runoff, and residential discharges. The complexity of modern day pollution complicates the clear delineation between tolerant, resistant, and sensitive species of diatoms (Patrick 1973). However, by examining diatom community assemblages, and determining shifts in species composition and structure over time, impaired water quality trends can be detected (Patrick 1973).

Methods and Materials

In 2007, periphyton will be sampled at fifteen stream riffle zone sites within the East Fork Poplar Creek (EFK), Bear Creek (BCK), White Oak Creek (WCK), Melton Branch (MEK) and associated reference sites. Specific site locations in stream kilometers (miles) and respective reference sites include (see Maps 1-2):

- *East Fork Poplar Creek:* EFK 23.4 (14.5), EFK 13.8 (8.6), and EFK 6.3 (3.9). Reference sites: Brushy Fork / BFK 7.6 (4.7) and Hinds Creek / HCK 20.6 (12.8)

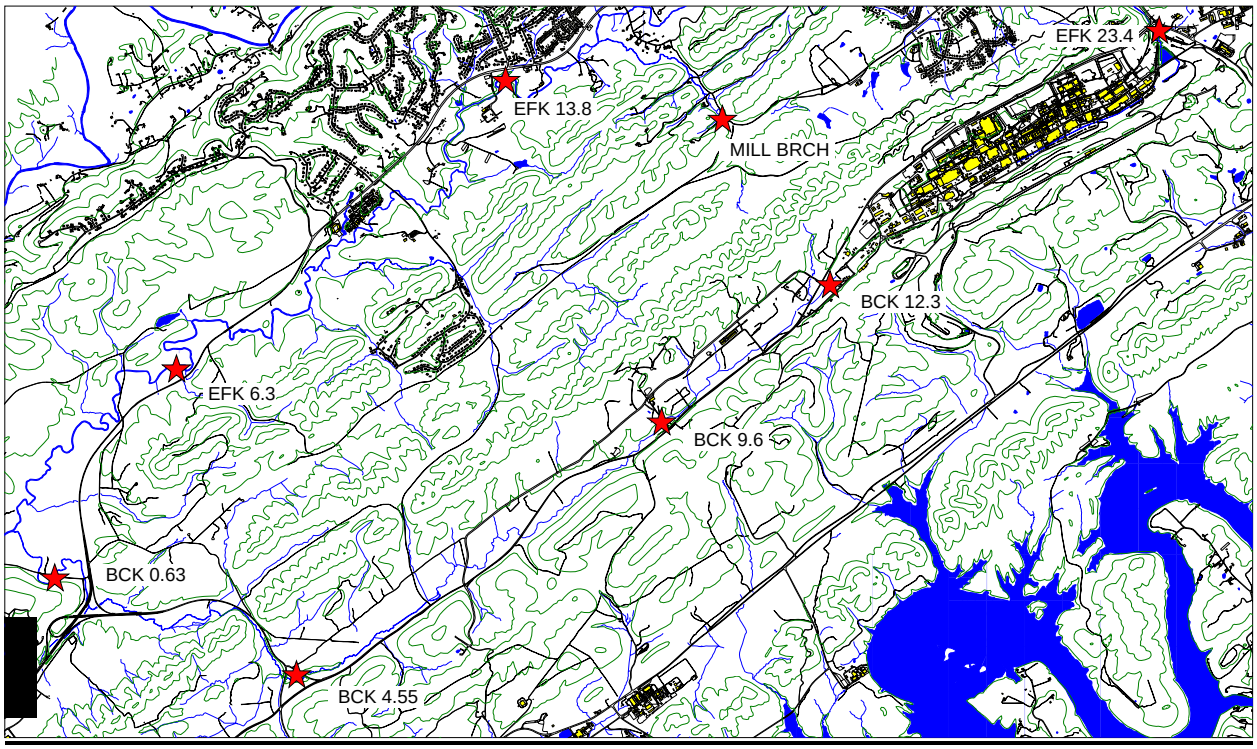
- *Bear Creek:* BCK 12.3 (7.6), BCK 9.6 (5.9), BCK 4.55 (2.8), and BCK 0.63 (3.9). Reference site: Mill Branch / MBK 1.6 (1.0)

- *White Oak Creek:* WCK 3.9 (2.4), WCK 2.9(1.8), WCK 2.3 (1.4), and Melton Branch / MEK 0.3 (0.2). Reference site: WCK 6.8 (4.2)

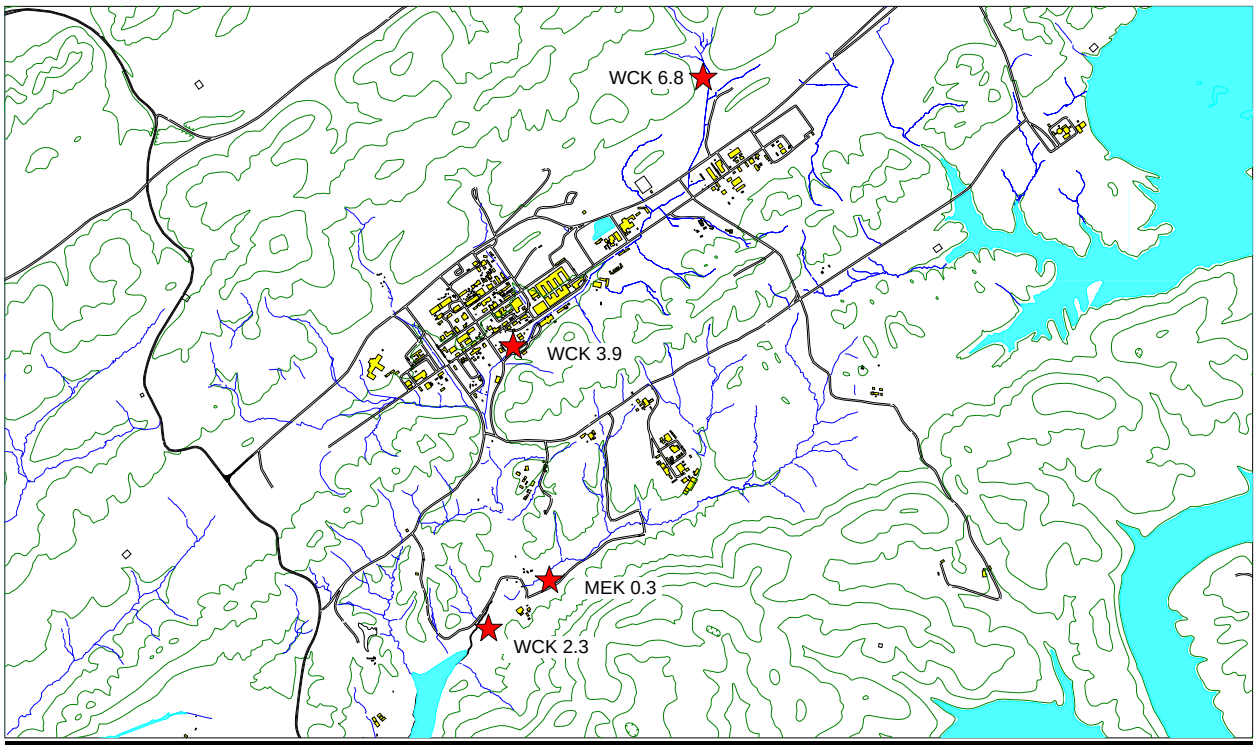
Field methods and protocols to be employed during this project will adhere to:

- U.S. EPA *Periphyton Sampling Protocol* (Barbour et al. 1999)
- U.S. EPA Environmental Monitoring and Assessment Program – *Surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams*, (Peck et al., 1999)
- Tennessee Department of Environment and Conservation (TDEC), Division of Water Pollution Control (WPC) *Regional Characterization of Streams in Tennessee with Emphasis on Diurnal Dissolved Oxygen, Nutrients, Habitat, Geomorphology and Macroinvertebrates* (Arnwine et al. 2005)
- *USGS Methods for Collecting Algal Samples as Part of the National Water Quality Assessment Program* (Porter et al. 1993).

The division's Environmental Monitoring and Compliance (EMC) personnel will employ artificial substrates composed of standard red bricks and four unglazed 2 x 2 inch ceramic tiles attached with stainless steel wire to provide a uniform surface for diatom colonization. Three bricks will be deployed at each monitoring site to allow colonization in various watershed habitats. The artificial substrates will be installed prior to January 2007, and will be stabilized using 12-inch rebar driven into the natural substrate. Substrates will be allowed to colonize 30-45 days before being sampled. Each brick will be submerged approximately 6-18 inches deep along riffle zones wherever possible.



Map 1: East Fork Poplar Creek and Bear Creek Diatom Monitoring Stations



Map 2: White Oak Creek and Melton Branch Diatom Monitoring Stations

The artificial substrates will be deployed and left submerged in situ to permit continuous periphyton colonization and stabilization over time. One tile will be randomly selected and removed from each

brick at all monitoring locations during quarterly sampling events. Sampling locations will be inspected monthly to determine the integrity of the treatments, repair possible storm surge water damage, and to clear debris that may have collected around the artificial substrates. Water temperature, conductivity, total dissolved oxygen and pH will also be measured using the Horiba U-10® Water Quality Checker. The results will be recorded in the field logbook during each sampling event. Additional real-time field data may be collected including flow velocity, water depths, canopy cover, and amount of light.

The diatom samples (tiles) collected in the field will be packed in ice and transported to the division laboratory where these will be prepared and refrigerated. Tiles will be brushed, and algae sample slurry carefully collected into labeled plastic vials. The diatom sample slurry removed from the tiles will be preserved with Lugol's solution. Samples will be archived and placed in cold, dark storage at 4º C. All project sampling and laboratory activities will adhere to the DOE Oversight Division's *Health, Safety, and Security Plan* (Thomasson 2004).

Water quality sample data collected twice a year by division staff will be used to support the periphyton-monitoring project. Water quality analytes will include:

(1) metals: As, Cd, Cr, Cu, Fe, Hg, Pb, Mn, and Zn
(2) physical parameters: pH, conductivity, temperature and dissolved oxygen
(3) microbiological: *E. coli* and *Enterococcus*
(4) nutrients: ammonia, NO_3 & NO_2 nitrogen, total Kjeldahl nitrogen and total phosphate
(5) radiological: gross alpha, gross beta and gamma radionuclides
(6) alkalinity (total as CaCO3), dissolved residue, suspended residue.

Replicate periphyton samples will be collected in every tenth stream sample for quality assurance/quality control (QA/QC) purposes. Percent Community Similarity (PCS) will be computed between the study site sample and the QC sample for that site. PCS will assess the similarity between the estimated densities of diatom species shared in both samples. These laboratory QA/QC procedures adhere to EPA methods for assessing periphyton communities in lotic systems (EPA 1998).

All samples will be examined in-house by division staff using the Olympus® BH-1stereo microscope, the TrueVision® XSP15B stereo microscope (w/ DCM 130 digital camera), and the Zeiss® inverted microscope. Identifications will be determined on both fresh sample material and cleaned diatoms. Enumeration of diatom cells in each sample will involve examining 2.45 ml of sample slurry in a settling chamber using the Zeiss inverted microscope. For consistency, at least 10 microscope FOVs will be counted to obtain a cell count of +500, or continue counting FOV until 500 cells are determined per sample. During enumeration, diatom taxa counts will be recorded on laboratory bench sheets and organized by genus. Non-diatom taxa (e.g., filamentous green algae, desmids, dinoflagellates) will also be recorded and counted. Periphyton samples with very low biomass may require counting up to a maximum of 100 FOV. The laboratory method for cleaning and mounting diatom slides will follow the methods of Brumley et al. (2001) and Hill (2004).

Digital microscopic images of diatom taxa will be routinely photographed for taxonomic archival records. If possible, every six months, one periphyton sample from each site will be sent to an outside contractor for taxonomic QA/QC purposes. The data and information generated by this

project will be used to meet the objectives as defined in the introduction and to form a database for calculating the diatom metrics.

Metrics

Analyses of the data collected in 2007 will include a measure of species richness, density, and diversity among the community species for each site. The Diatom Bioassessment Index (DBI, KDOW 2002) is a multi-metric index that uses six diatom community structure metrics. It is intrinsically designed to be sensitive to nutrient enrichment, as well as other pollutants including sedimentation salinity, acidity, and metals. Diatom indicators of environmental conditions can be more precise than one-time sampling and assessments of water chemistry. The DBI indicators are:

(1) Total Number of Diatom Taxa (TNDT). This gives the total number of taxa identified (those counted & those showing up on a scan of the slide) and estimates diatom taxa richness.
(2) Shannon Diversity. This is an index used to characterize species diversity (species proportion for all species in a particular ecosystem, e.g., EFPC).
(3) Pollution Tolerance Index (PTI). Each taxa is assigned a tolerance value based on their tolerance to increased pollution. Tolerance values range from 1 (most tolerant) to 4 (most sensitive) and are derived from Lange-Bertalot (1979).
(4) *Cymbella* Group Richness (CGR). This is the total number of taxa from the following genera: *Cymbella, Cymbopleura, Encyonema, Encyonemopsis, Navicella, Pseudoencyonema*, & *Reimeria.*
(5) *Fragilaria* Group Richness (FGR). This is the total number of taxa from the following genera: *Ctenophora, Fragilaria, Fragilariforma, Pseudostaurosira, Punctastriata, Stauroforma, Staurosira, Staurosirella, Synedra*, & *Tabularia*
(6) % *Navicula, Nitzschia, Sururella* (%NNS). This is the sum of the relative abundances of all *Navicula, Nitzschia*, & *Sururella* taxa.

The six DBI indicators are then used to obtain a score between 1 and 5 for each monitoring site. Diatom taxa can infer stressors involved in lowering the biological integrity of a site. For each assemblage, a rating (excellent to very poor) is derived from each index score. A numeric score is then assigned based upon the narrative rating (5 = excellent and 1 = very poor).

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Canada Geese Monitoring

Introduction

A large population of Canada geese, both resident and transient, visits the Oak Ridge Reservation (ORR). While migratory geese have always visited East Tennessee, Tennessee Valley Authority (TVA) and the Tennessee Wildlife Resources Agency (TWRA) introduced the resident population to the Melton Hill region in 1972. Geese prefer to eat grass, but will also eat water plants including root nodules from bottom sediment. Studies in the 1980s demonstrated that geese associated with the contaminated ponds/lakes on the ORR can accumulate radioactive contaminants quickly and, that contaminated geese frequent off-site locations. The thriving goose population in this area makes this animal an easily accessible food source for area residents. Although hunters are offered the opportunity for a radiological screening of their kills, not many take advantage of this service (TWRA, personal communication).

Results of Tennessee Department of Environment and Conservation, Department of Energy Oversight Division (the division) off-site sampling in 1999 showed no elevated levels of radioactivity in the geese sampled. Similarly, all geese captured during the 1999, 2000, and 2001 "goose roundups" were below the 5-pCi/g game confiscation level, which DOE Oak Ridge has set as an administrative guideline. During the 2002 ORR "goose roundup," three geese were captured from ONRL that had Cs-137 levels above the 5 pCi/g game confiscation level. Geese subsequently captured in off-site sampling at the Oak Ridge Marina showed no Cs-137 or other contamination above the confiscation level. During the 2006 "goose roundup," all geese sampled were below the 5 pCi/g game confiscation level.

Geese with elevated levels of Cs-137 in muscle tissue have been found primarily in areas near ORNL. A study in September 1998 found elevated levels of Cs-137 in grass and sediment at two reaches of White Oak Creek south of the 3513 Pond and in grass around the 3524 Pond. Sediment in and around White Oak Lake (WOL) and White Oak Creek has elevated levels of Cs-137. Canada geese have been observed on WOL and throughout the ORNL area. After a flock of radioactive geese was found at ORNL in 1998, DOE took several measures to discourage the geese from using and feeding in contaminated areas. Flagging and fencing were improved and several areas were defoliated. These measures appear to have been successful, with no significantly contaminated geese being captured on or off the reservation in 1999 through 2001. State geese sampling would only take place if any of the geese captured in the 2007 "goose roundup" show significantly elevated levels of radioactivity (above 5 pCi/g). This would indicate the possibility of radioactively contaminated geese leaving the reservation.

Methods and Materials

During the week preceding the "goose roundup", areas around the perimeters of the ORR will be scouted to identify locations of possible populations of geese. This will facilitate activities on the day of collection by predetermining likely locations to sample.

Sampling would take place immediately after the annual ORR "Goose Roundup" with equipment and assistance from TWRA and ORNL. Geese are molting in mid-June and are nearly flightless at this time. Sampling would take place over a one- to two-day period. Variables such as flock location and ease of capture will affect the schedule.

The site selected should be near contaminated vegetation, water, and sediment. An optimum site is the Jones Island area in Loudon County. Geese from this area have access to White Oak Lake and other contaminated ORNL sites. Due to recent movements of populations, the most likely locations will be the Oak Ridge Marina and the Solway Park areas.

Geese would be captured using the same technique as the DOE "goose roundup". Eight to fifteen people would slowly converge on a flock of geese forcing them into a temporary enclosure consisting of chicken wire and reinforcing bar. At least 15 individual geese would be captured to assure accuracy of the reading and a representative sample of the flock. Geese would be transported in cages to the TWRA check station for weighing, sexing, and a whole body count. All activities would be carried out in compliance with the division's *Health, Safety, and Security Plan* (2004).

Results of the whole body count would determine the necessity for further analysis of the geese. If the whole body counts showed the radioactive contamination of the geese to be 5 pCi/g or greater, muscle tissue from the contaminated geese will be radiologically analyzed to confirm the results of the whole body counts and to determine if other contaminants are present. Additional analyses would be for cesium-137, mercury, cadmium, selenium, and lead in the breast and/or leg tissue of geese with whole body counts above 5 pCi/g. Up to six geese (two high, two medium, and two low whole body counts) would be analyzed from a contaminated flock.

Most material will be provided by TWRA. This includes:

- fencing
- cages
- tags

The whole-body counters are the property of ORNL and would be operated by their personnel.

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Monitoring of Aquatic and Terrestrial Plants in Surface Water and Ecological Habitats on the Oak Ridge Reservation

Introduction

The gathering of collateral information in support of the division's groundwater monitoring efforts at springs and surface waters will be a priority of this project. If surface water bodies (springs and ponds) have been impacted by hazardous substances, it is likely that aquatic organisms in the immediate vicinity could be uptaking radionuclides or other hazardous substances. The focus of the plan will be the detection and characterization of hazardous substances bioaccumulated by this aquatic and terrestrial vegetation to determine ecological and human health risk factors.

Target vegetation for sampling will include (but not be limited to): 1) watercress; 2) green algae (*Ulothrix, Spirogyra, Oedogonium*, etc.); 3) periphyton (benthic algae; see discussion below); 4) mosses (Bryophyta); 5) liverworts (Hepatophyta); 6) horsetail and quillworts (*Equisetum and Isoetes*); 7) floating & attached aquatic plants (*Azolla, Lemna, Wolffia, Salvinia*); 8) club moss (*Huperzia sp*.); and 9) lichens (*Cladina sp.* and *Cladonia sp.)*. These plant species have been selected because they are excellent bioindicators and are remarkably sensitive to pollution, radioactive fallout, and other hazardous substances (e.g., pathogenic organisms, chemicals, metals, etc.). Also, the plants are known to be ingested by aquatic organisms and herbivores.

Watercress, a floating, rooted aquatic plant (angiosperm) has been selected for its affinity to thrive in its natural habitat, the clear, slow-moving water near the mouths of springs. If the spring water is impacted, aquatic plant species are likely to have absorbed some of the hazardous substances.

Green algae and periphyton occur in most of the aqueous environments within ORR watersheds (e.g., Upper East Fork Poplar Creek). Periphyton refers to communities of microorganisms that are attached to various aquatic substrates and grow as thick gelatinous mats of mixed assemblages. These include green algae, cyanobacteria, fungi, associated macrophytes (e.g., cattails, duckweed, water spangles, etc.), invertebrate grazers (e.g., snails), and detritus. For many aquatic organisms and herbivores, periphyton biomass produces much of the low end of the food chain. They are sensitive indicators of environmental physiochemical change and bioaccumulation of hazardous substances.

Prospective habitats, both on and off of the ORR, such as springs, seeps, karst features, streams, wetlands, impoundments (ponds), landfills, creek embankments, rock outcrops, State Natural Areas, and other terrestrial ecosystems will receive priority as potential monitoring sites (see Figures 1 and 2). Watersheds such as Bear Creek and its tributaries, White Oak Creek/Lake and its tributaries, and Mitchell Branch are all probable target habitats for sampling.

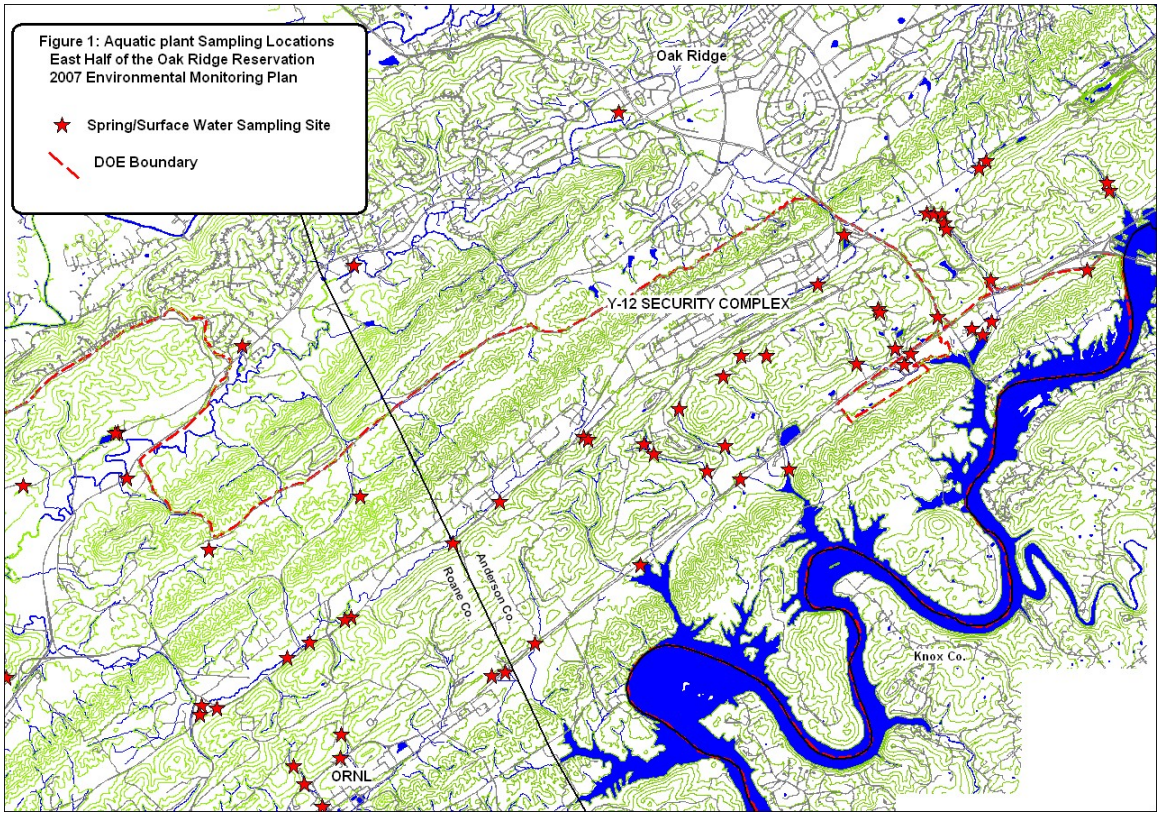

Figure 1: Potential Aquatic Plant Sampling Locations - East Half of ORR

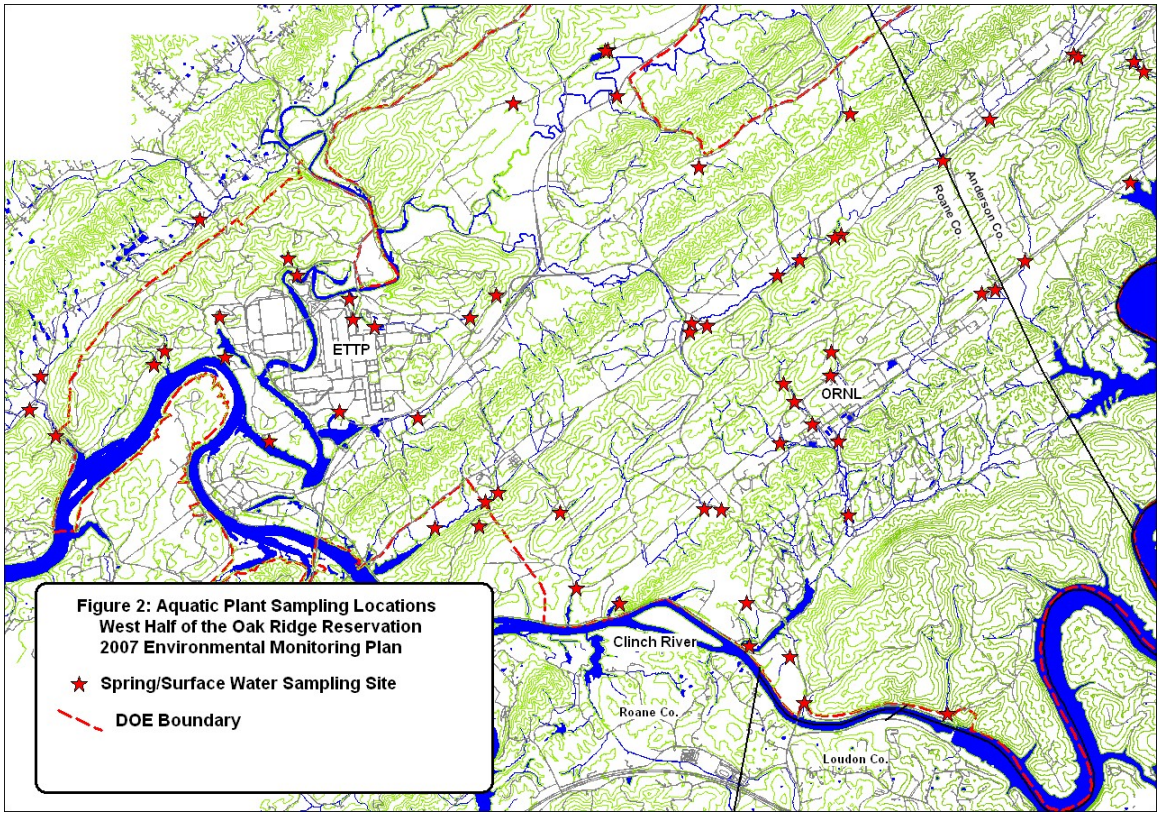

Figure 2: Potential Aquatic Plant Sampling Locations – West Half of ORR

The first two sampling seasons (2002-03) concentrated on the sampling and analysis of watercress, algae, and aquatic vegetation. In 2004, the project broadened in scope to include determinations of the ecological implications of these findings. In 2005, the focus was turned to the highest results from previous sampling to determine if a threat existed. In 2006, a spring and seep survey was conducted near areas of concern in order to more closely evaluate potential hot spots. In 2007, the monitoring will again return to the highest results from previous sampling locations in order to determine if natural attenuation is occurring.

Methods and Materials

Field samples will be collected at habitats and ecosystems both on the ORR and offsite (for background data). Plastic zip-lock baggies and plastic (jar-like) containers will be used for collection of samples in the field. Rubber/plastic gloves will be worn during sampling activities. Each sampling location will be assigned an identification number (established spring names will be used for watercress samples) and mapped using global positioning system (GPS) technology.

Arrangements will be made in advance with appropriate Tennessee Oversight Agreement site coordinators to orchestrate ingress/egress to radiological areas, to obtain Radiation Worker Permits (if necessary), and to arrange for the presence of health physics technicians on an as-needed basis. All samples will be screened radiologically in the field prior to returning to the division's office. Using radiological counting equipment available in the division laboratory, exposure rates will be calculated from selected field samples to determine exposure, absorbed dose, etc.

Samples collected will be shipped to Laboratory Services in Nashville for analysis of gross alpha, gross beta, and gamma radionuclides. Target radionuclides occurring in the ORR environment as contamination include (but are not limited to):

(1) Cesium-137
(2) Strontium-90
(3) Cobalt-60
(4) Uranium isotopes and daughter products
(5) Technetium-99

Sampling protocol and quality control methods will follow the guidelines in the division's "Standard Operating Procedures" and "Health, Safety, and Security Plan." Field techniques and laboratory methods will follow standard ASTM, EPA, and FRMAC methodology, sampling, and operating procedures. Standard Operating Procedures for the project include (but are not limited to):

(1) ASTM Guidelines:
ASTM Volume 11.02 – Organic Constituents/Radioactivity/Microbiological
ASTM Volume 11.05 – Biological Effects & Environmental Fate/Biotechnology
ASTM Volume 12.02 – Nuclear/Solar/Geothermal/Dosimetry/Radiation Effects

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Vol. 1 – Radiation Monitoring & Sampling - Field Sampling: Vegetation/Fruit Sampling, Supplies and Procedure.
Vol. 2 - Sample Preparation and Analysis – Method 6: Preparation of FRMAC Field Samples

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DRINKING WATER MONITORING

Sampling of Oak Ridge Reservation Potable Water Distribution Systems

Introduction

The water distribution systems at each of the DOE ORR sites are regulated by the *Tennessee Safe Drinking Water Act,* (T. C. A. 68-13-701), and by the *Regulations for Public Water Systems and Drinking Water Quality* (Chapter 1200-5-1). The Tennessee Department of Environment and Conservation, Department of Energy Oversight Division (the division) may conduct oversight of sampling for total coliform bacteria and free chlorine residuals at various sites throughout the potable water distribution systems on the Oak Ridge Reservation (ORR). In addition, the division may oversee ORR line-flushing practices, water main repairs, cross-connection control programs, and water-loss/leak detection activities in order to identify potential threats to the potable water supply. If potential threats are identified, then additional chemical and radiological sampling may be conducted during 2007 to insure that the quality of the potable water is maintained.

The division, through a memorandum of understanding (MOU) with the TDEC Division of Water Supply (DWS), reviews chemical and bacteriological sampling results from the drinking water distribution systems on the ORR. Review of these sampling results will be combined with:

- knowledge of localized plant populations and water demand,
- backflow device location,
- testing and maintenance procedures, and
- line repairs or maintenance.

When evidence exists of possible shallow subsurface plume infiltration, cross connections, low chlorine residuals, or other upset conditions, the division will use site maps to identify the proximity of water lines to radiological or non-radiological source waters. We will use this as a basis for independent sampling.

Confirmation of any positive results reported can dictate additional sampling or split samples. Continued positive results may justify increased monitoring for that compound.

In addition, review of Cross Connection Control Programs will be conducted to evaluate the effectiveness of such plans and the degree of protection afforded by them. This will be checked by verifying inspection dates on backflow prevention (BFP) devices, review of records of BFP devices and inspection for possible unprotected cross connections.

Additional information concerning potential threats to water distribution systems is provided in a set of articles (http://www.epa.gov/safewater/tcr/tcr.html#distribution) prepared for the EPA. The papers only present available information and do not represent EPA policy.

Methods and Materials

The following sections provide information regarding the sample processing and analytical laboratory procedures.

Free Chlorine Residual
The sample will be collected into two of the small sample containers provided with the Hach® Pocket Colorimeter Kit. One of the samples will be designated as the blank and the other will be the actual sample to be analyzed. A DPD powder pillow (test reagent) is poured into the sample container and gently shaken and allowed to sit for three minutes. After three minutes, the blank is placed into the pocket colorimeter and the "zero" button is depressed. The blank is removed and replaced with the sample container. The "read" button is depressed and the free chlorine residual is read directly from the pocket colorimeter display.

Bacteriological
The U.S. Environmental Protection Agency (EPA)-approved method for coliforms (Colilert® in the pass/fail mode) will be the methodology utilized by Laboratory Services. The lab has expertise in a broad scope of services and analyses available to the division and other TDEC divisions statewide. For bacteriological testing on raw water sources, the counting application of the Colilert kits would be identified and utilized.

Independent chlorine and bacteriological sampling will be conducted monthly at one of the three DOE facilities. Reasonable attempts will be made to rotate sampling between facilities each month. Specific sampling sites and number of samples to be taken will be determined based on water usage patterns, distribution system layouts, and other factors, such as construction activities and line breaks.

Organic, Inorganic and Radiological
Analytical methods are provided in the Standard Operating Procedures (SOP) manuals for Laboratory Services. The SOPs refer to proper EPA and/or other methods. In order to assess methods used, division staff should communicate with their sampling and analytical counterparts within the ORR on a basis that facilitates technical exchange and openness. General sampling and analysis methods will follow EPA guidelines as listed in the appropriate section of Title 40 of the Code of Federal Regulations (CFR).

Sampling of organic, inorganic, and radiological constituents will be conducted on an as needed basis when it has been determined that a possible threat to the quality of the drinking water exists.

Quality Control/Quality Assurance
If independent sampling activities are conducted, care will be taken to include quality control samples. The level of quality control methodology implemented will be commensurate with the level of independent sampling. Forms of control sampling to be considered will be blanks, duplicate analysis, division-split samples, or even-split samples with site DOE contractor. Information pertaining to the quality control samples will be included in program files and spreadsheets.

Equipment that will be required to accomplish this oversight and sampling project include:

- latex gloves
- Hach Pocket Colorimeter Kit
- Hach free chlorine DPD powder pillows
- bound field book
- state vehicle

- *Health, Safety, and Security Plan*
- sample bottles
- sampling cooler
- disinfectant (full strength) spray bottle

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RadNet Drinking Water Program on the Oak Ridge Reservation

Introduction

Radiological contaminants released on the Oak Ridge Reservation (ORR) enter local streams and are transported to the Clinch River. Though monitoring of the river and local water treatment facilities has indicated that concentrations of radioactive contaminants are below regulatory criteria, the possibility that ORR pollutants could impact area water supplies remains. In response to this potential, the Tennessee Department of Environment and Conservation, DOE Oversight Division (the division) began participation in EPA's Environmental Radiation Ambient Monitoring System (ERAMS) in 1996. This program, now called RadNet, provides for radiological monitoring of public water supplies near nuclear facilities throughout the United States. In this regard, the RadNet program is designed:

- to monitor pathways for significant population exposure from routine and/or accidental releases of radioactivity,
- to provide data indicating additional sampling needs or other actions required to ensure public health and environmental quality and,
- to serve as a reference for data comparison (U.S. EPA, 1988).

The program also provides a mechanism to evaluate the impact of DOE activities on water systems located in the vicinity of the Oak Ridge Reservation and to verify DOE monitoring in accord with the *Tennessee Oversight Agreement* (TDEC, 2006).

Methods and Materials

As in the past, EPA will provide radiochemical analysis of finished drinking water samples collected quarterly by division staff at five public water supplies located on, and in the vicinity of, the ORR. This analysis will be performed at EPA's National Air and Radiation Environmental Laboratory in Montgomery, Alabama. When received, the results will be compared to each other (to identify anomalies) and to DOE/EPA drinking water standards (to assess DOE compliance, the adequacy of contaminant controls, and any associated hazards). Analytical parameters and the frequencies of RadNet analysis are provided in Table 1.

The five Oak Ridge area monitoring locations in the program are the Kingston Water Treatment Plant, the Gallaher (K-25) Water Treatment Plant, West Knox Utility, the City of Oak Ridge Water Treatment Facility (formerly the DOE Water Treatment Plant at Y-12), and Anderson County Utility District. Figure 1 depicts the approximate locations of raw water intakes associated with these facilities.

Table 1: RadNet Analysis for Drinking Water

ANALYSIS	FREQUENCY
Tritium	Quarterly
Gross Alpha	Annually on composite samples
Gross Beta	Annually on composite samples
Gamma Scan	Annually on composite samples
Iodine-131	Annually on one individual sample/sampling site
Radium-226	Annually on samples with gross alpha >2 pCi/L
Radium-228	On samples with Radium-226 between 3-5 pCi/L
Strontium-90	Annually on composite samples
Plutonium-238, Plutonium-239, Plutonium-240	Annually on samples with gross alpha >2 pCi/L
Uranium-234, Uranium-235, Uranium-238	Annually on samples with gross alpha >2 pCi/L

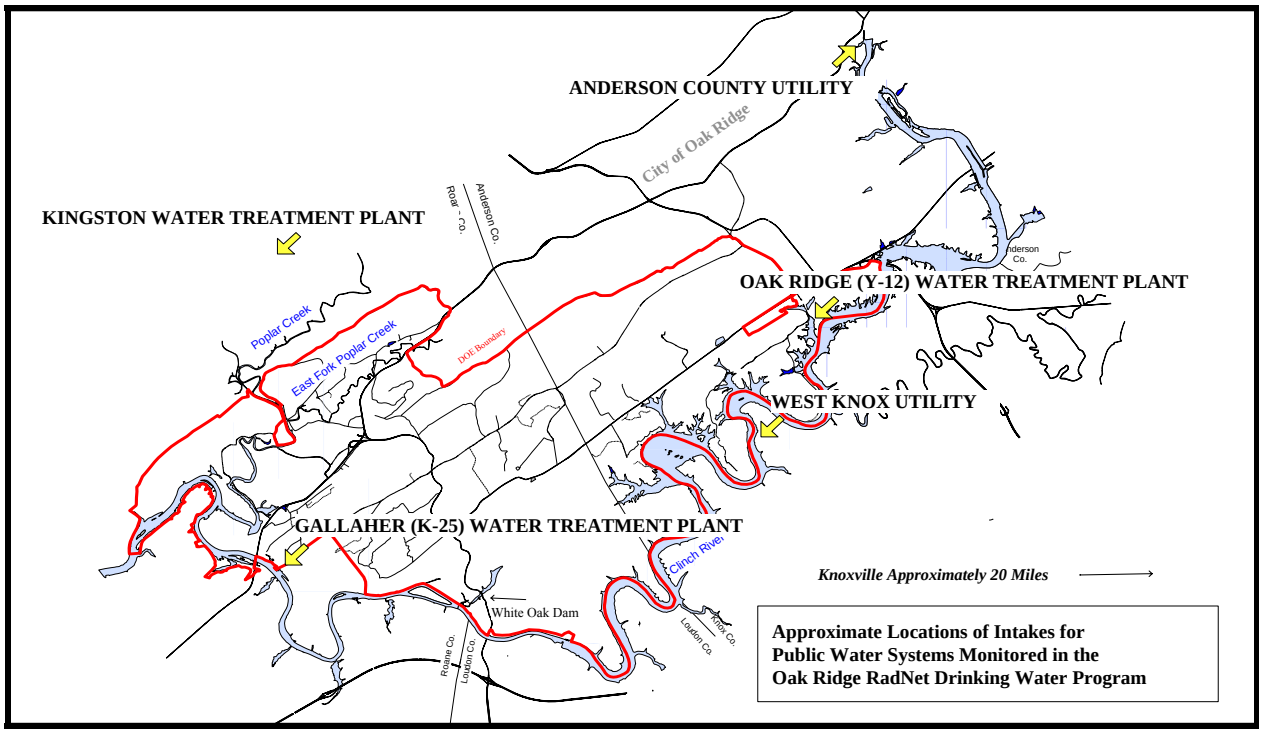

Figure 1: Approximate Locations of the Intakes for Public Water Systems Monitored in Association with EPA's RadNet Drinking Water Program

References

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GROUNDWATER MONITORING

Oversight Groundwater Monitoring Plan for the Oak Ridge Reservation and its Environs

Introduction

To protect the people and environment of East Tennessee with respect to wastes and contaminants generated by Department of Energy (DOE) operations (both legacy and current), the division conducts oversight monitoring of the groundwaters within the Oak Ridge Reservation and its environs. This is accomplished according to the mission of the state's Department of Energy - Oversight Office (DOE-O) as established under the Tennessee Oversight Agreement (TOA) and the Federal Facilities Agreement (FFA).

The primary goals of the DOE-Oversight division's groundwater sampling program are:

- to perform surveillance to detect changes in groundwater quality at select locations,
- to locate groundwater exit pathways,
- to locate groundwater impacts from past DOE Oak Ridge Reservation (ORR) operations both on-site and off-site, and
- to integrate groundwater sampling with surface water sampling to produce a comprehensive monitoring report.

It should be emphasized that DOE-O groundwater monitoring is not intended to be a comprehensive and integrated monitoring program. Nor are the resources allocated for this monitoring. Rather the division's groundwater monitoring is designed, in accordance with its oversight role, to perform as an assurance check on DOE groundwater monitoring quality, to monitor sites of specific interest to the State of Tennessee, and then, to the extent possible, provide monitoring in gaps identified in the DOE groundwater monitoring program.

To the extent that gaps are identified in DOE's program and the monitoring that the division performs, the purpose is not to replace DOE monitoring but to direct DOE, and its extensive resources, to areas of groundwater concerns identified by the division.

Sites for groundwater monitoring to be performed by the division in 2007 can be divided into onsite and off-site locations. Onsite locations can be further subdivided by proximity to or inclusion within the three main plant sites: Y-12, ETTP, and ORNL. It is further useful to divide the ORNL sampling into Bethel Valley (containing the main campus) and Melton Valley, which contains numerous legacy waste sites, non-operational experimental reactors and the operational High Flux Isotope Reactor (HFIR). A separate DOE facility, known as South Campus or the Scarboro Facility, is located in the former town of Scarboro at the east end of Bethel Valley. The South Campus is considered separately for division groundwater monitoring purposes.

Onsite Groundwater Monitoring

Onsite monitoring sites are determined according to locations of known waste disposal areas and in consideration of the known geologic and hydrologic framework of the ORR. Analyses performed

are chosen with the knowledge of facility processes, legacy waste practices, and concurrent and/or planned remedial activities.

A general example of how contaminants of concern are chosen for analysis is demonstrated by the discovery of a predominance of different radionuclides associated with the different sites. Thus, technetium 99 is part of general analysis for ETTP, tritium for Melton Valley, and uranium for Y-12. From prior knowledge, certain nuclides are presumed to be present in some areas (e.g. strontium 90 near ORNL). More expensive isotopic analysis is only employed when certain gross levels shown on the basic analyses are exceeded. Spectrographic analysis for gamma-emitting radiochemicals will be performed on most samples collected.

Determination of the specific metals and chlorinated solvents to be analyzed is performed on a site-by-site basis. The selection process is more general than that of the process for radiochemicals. On new locations, or on locations that are infrequently sampled, an expanded list of compounds is used. Certain metals such as mercury require separate analysis and are generally only performed on the basis of site knowledge.

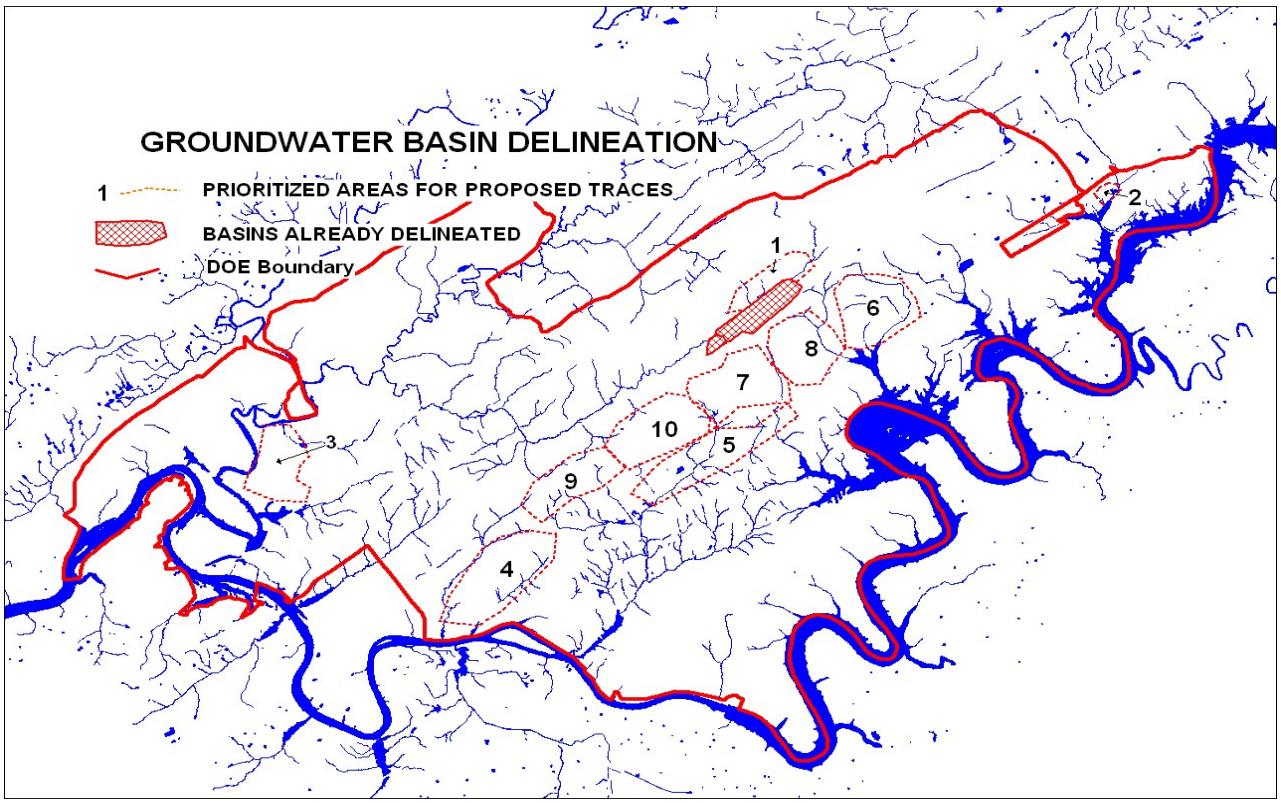
The surface water/groundwater regime of Bear Creek Valley contains a large number of radiochemicals. Routinely, the division tests for total alpha and total beta activities. Spectro-graphic analysis for gamma-emitting radiochemicals is also carried out. It is expected that the typical analyses for radiochemicals in Bear Creek Valley will include specific tests for "soft" beta emitters that are not detectable other than by means of liquid scintillation. Typically such tests are used to determine the presence of technetium 99 and tritium, along with a number of other fission and activation products. The division will utilize such analyses on a far more frequent basis in 2007 than in previous years.

Dye Tracing

A subset of onsite groundwater monitoring will be included in the division's ongoing effort to delineate groundwater basins, or, more simply put, to understand where water enters the groundwater systems on the reservation, where they exit the systems, and what, if any, contaminants are acquired in the process. Tracer tests will be performed by injecting fluorescent dye into the groundwater system either in sinkholes or wells. Then an attempt is made to recover the dye or dyes at springs and/or other wells. Generalized pathways and flow rates for groundwater can be determined by observing the time and distance between input/extraction events for the dye(s). Groundwater basins are delineated in this manner.

Groundwater basin delineation is important to understand the fate and transport of contaminants within the ORR. This knowledge is used to indicate proper locations for monitoring groundwater contamination and for predicting monitoring locations of maturing contaminant plumes. The division's activities regarding groundwater basin delineation are dependant on the availability of personnel and resources.

The division prioritizes a dye trace from the southwest area of the SNS site on Chestnut Ridge. Expected flow is toward the significant Maynardville Formation/Knox Group springs located on the base of the escarpment of Chestnut Ridge. Another expected flow is toward the numerous smaller, but not insignificant, springs that originate in the portion of the Knox Formation that forms the headwaters of White Oak Creek. (See Map 1)



Map 1: Basin Delineation

Groundwater Tracing

Documentation of individual traces will indicate the types and amounts of dye to be flushed, the placement and monitoring locations, and maps showing trace locations in relation to active or inactive DOE facilities. This information will be contained in a separate addendum to be distributed to the Resource Management Organization for the ORR, Laboratory or Plant Shift Superintendent, DOE contacts, UT-Battelle/Bechtel Jacobs/BWXT contacts and the division managers.

General Dye Sampling

In 2007, as in 2006, all groundwater sampling sites will be routinely monitored for fluorescent dyes as part of the general analyses performed at all locations. This will be done to establish backgrounds for potential tracing studies and to recognize that fluorescent dyes are utilized at various times for various reasons within the main plants. Observation of fluorescent dyes in division groundwater sampling sites will allow identification of original source locations as well as their pathways.

Off-site Sampling

The division expects to maintain an active role performing oversight monitoring of groundwater in the environs of the Oak Ridge Reservation in calendar year 2007. Sites sampled off the reservation generally consist of domestic wells or springs located on private property. Ten of these sites were sampled during the division's 2006 groundwater monitoring efforts.

The division expects to continue to monitor these sites during 2007. A potential exists for additional sites to be added to the monitoring effort as requests by the public are made or as sites of interest are discovered. The location of acceptable sites and determination of sampling frequencies will be established based on geohydrologic knowledge of the area, proximity to current and past DOE operations and by requests for access to privately-owned wells and springs.

Sampling frequencies are also based on evaluation of analytical results. Sampling may be conducted once every two years or even less frequently. Reasons for this could be if the particular site is deemed to be a less-than-optimal location for monitoring potential DOE impact to off-site groundwaters, or if other nearby sites are considered to provide adequate coverage of an area.

The 2007 plan calls for careful consideration and probable sampling of water wells located on the periphery of the ORR. If there is any potential for contaminants to affect a particular site, division sampling efforts will target the area located on the west bank of the Clinch River, beginning just southwest of Melton Valley and continuing northwest to the historic K-25 site. These areas are typically served by domestic water wells. Though it is considered unlikely, masses of contaminants and the potential for mobilizing those contaminants does exist.

In its oversight role, the division plans for its off-site groundwater sampling to act as a check (and an assurance) on the DOE's off-site groundwater monitoring and surveillance of the Oak Ridge Reservation and its environs. This goal will not be met in 2007, as there is no scheduled DOE off-site groundwater monitoring program in progress.

The division will, within the resources allocated to groundwater monitoring and within the scope of its mission, attempt to provide as much coverage of off-site groundwater as is feasible. We expect, in 2007, to add offsite locations as they become available. This may be through requests received from the public or by the division's initiative in contacting private well owners who have locations meeting the monitoring criteria cited above. It is possible that up to ten more sites may be added to the division's groundwater sampling routine.

Reconnaissance

The division relies on the sampling of springs and seeps to perform oversight monitoring of DOE's current and legacy operations on the ORR. For this reason, the groundwater program maintains a fairly intensive effort to locate springs and seeps that are potentially impacted by those activities.

In 2007, several areas on the reservation will be targets of division reconnaissance for the location of potential sampling sites. They are

- an area Northeast of the main campus of ORNL,
- the slope areas of Copper Ridge,
- the marsh areas along Poplar Creek in the ETTP area, and
- a side scan sonar survey of the Clinch River at Watts Bar Lake.

Miscellaneous Groundwater Field Work

Other groundwater-related activities are also performed by division personnel as the need arises. These may include

- the inspection of wells,
- the oversight of Underground Injection Control (UIC) wells and,
- the drilling of new wells and/or the plugging of abandoned wells (P&A).

Methods and Materials

Sampling will be located along the geologic strike and along cross-strike geologic features in the vicinities of the Y-12, X-10, ETTP and South Campus facilities. Water supply wells will be sampled by collecting water as close to the wellhead as possible. This will entail purging for at least 20 minutes or after field parameters stabilize. Monitored wells will be co-sampled by facility personnel. A few exceptions will be when disposable bailers might be used. Parameters, such as, pH, temperature, and conductivity will be collected and recorded before sampling. Springs will be sampled based on two field observations, those of flow and those of safety considerations. (See Appendix A.)

Table 1 contains locations, analyses and sampling periods for the division's groundwater monitoring effort. Specific radiochemical analyses will be determined and/or modified upon consultation with the division's Radiological Monitoring Oversight Program (RMO). Typically, waters known to be influenced by K-25 would be analyzed for Tc-99. Water influenced by X-10 or by the EMWMF will include Sr-90 analysis (if gross beta results so warrant). Should gross alpha analysis in Bear Creek Valley appear to be greater than what is normally encountered, isotope-specific analysis for transuranic elements may be employed. For domestic water supplies, if the gross alpha activity is greater than 5 pCi/L, then a radionuclide isotope-specific analysis for alpha emitters will be performed on the laboratory-archived sample.

Table 1: Sampling and Analysis Matrix for the 2007 Groundwater Monitoring Program

Area	**Sampling Locations**	**Quarterly Sampling Schedule**			
		Q1	**Q2**	**Q3**	**Q4**
Y-12 Landfills	Mt. Vernon Mossy Rock Spring Cephus Spring Cabin Spring West Railroad Spring	Rad 1 Metals Inor VOCs Dye			Rad 1 Metals Inor VOCs Dye
EMWMF (Sampling by RMO)	Covered by the Rad. Monitoring Program Water Section	Rad Metals Inor Dye		Rad Metals Inor Dye	
Bear Creek	SS-7 Spring SS-6 Spring SS-5 Spring SS-8 Spring -(yearly) New Weir –(no VOCs) BC km-4.55 –(no VOCs)	Rad 3 VOCs Nut Dye	Rad 3 VOCs Nut Dye	Rad 3 VOCs Nut Dye	Rad 3 VOCs Nut Dye

K-25	USGS 10-895 –(monthly) Doug's Drip PCO Seep Syncline Spring 21-002 Spring Rubble Seep Tree Hole Spring SW-31 Ditch Tom's Seep Z-boil Spring USGS 8-900 Cedar Spring	VOCs Rad 2 Dye VOCs DYE VOCs Metals Inor Rad 2 Dye	VOCs Rad 2 Dye VOCs DYE VOCs Metals Inor Rad 2 Dye	VOCs Rad 2 Dye VOCs DYE VOCs Metals Inor Rad 2 Dye	VOCs Rad 2 Dye VOCs DYE VOCs Metals Inor Rad 2 Dye
SNS	SNS Spring 1 SNS Spring 2 SNS Spring 3 SNS Spring 4 SNS Spring 5 (once located again) SNS Spring 6 SNS Spring 7 Cress Spring	Rad 1 Dye		Rad 1 Dye	
Bethel Valley	Burns Cemetery Raccoon Cr. Spring Sycamore Spring. Gerry's Spring Crooked Tree	Rad 4 VOCs Dye		Rad 4 VOCs Dye	
Scarboro/Union Valley	Cattail Spring- (monthly) Bootlegger Spring – (monthly) Arboretum Wells	Rad 1 VOCs Dye	Rad 1 VOCs Dye	Rad 1 VOCs Dye	Rad 1 VOCs Dye
Melton Valley	Picket Wells TBD Wetland Spring Peryam Spring Melton Valley Multiples	Rad 4 VOCs Dye		Rad 4 VOCs Dye	
Off-Site	Rose Bailey Lake Spring Wells (Q) Regina Loves Bobby Spring (Q) Love Spring (Y) Dead Horse Spring (Y) RWA-29 (Y)	Rad 2 VOCs Metals Dye	Rad 2 VOCs Metals Dye	Rad 2 VOCs Metals Dye	Rad 2 VOCs Metals Dye

	RWA-22 (Y) RWA-56 (Y) RWA-65 (Y) RWA-74 (Q) RWA-75 (Y)	Rad 4 VOCs Metals Dye	Rad 4 VOCs Metals Dye	Rad 4 VOCs Metals Dye	Rad 4 VOCs Metals Dye
Tracing	EMWMF SNS South Campus East Tennessee Technology Park Raccoon Creek Area	Dye	Dye	Dye	Dye

Table Notes:
Q = sample collected quarterly
Y = sample collected annually
Rad 1 = sample for radiochemicals: Gross Alpha, Gross Beta, Gamma Radionuclides
Rad 2 = sample for radiochemicals: Gross Alpha, Gross Beta, Gamma Radionuclides, Tritium, Technetium 99
Rad 3 = sample for radiochemicals: Gross Alpha, Gross Beta, Gamma Radionuclides, Strontium89/90, Tritium, Technetium 99
Rad 4 = sample for radiochemicals: Gross Alpha, Gross Beta, Gamma Radionuclides, Strontium89/90, Tritium
VOCs = sample for Volatile Organic Compounds
Nut = sample for Nutrients (Nitrate – Nitrite)
Metals = sample that is analyzed for the metals Arsenic, Beryllium, Cadmium, Chromium, Cobalt, Nickel, Lead, Selenium, Thallium, Vanadium, Mercury
Inor = general inorganic parameters: Alkalinity as CaCO3, Boron, Chloride, Conductivity, Nitrogen NO3 & NO2, pH, residue dissolves, residue, suspended, sulfate
Dye = samples for dye resulting from dye traces by contractors, utilities, or TDEC DOE-O

New sampling locations will include cation/anion (the individual makeup of water) parameters in order to calculate ionic charge balances. A list of metals that may include the health-based analytes will be considered for analysis at new locations. Volatile organic compounds (VOCs) will be sampled at all new springs. At sampling points where metals, VOCs or radionuclides indicate a need to determine their variability, then appropriate samples will be taken.

As new contaminants, such as 1-4 dioxane are identified by the regulatory and monitoring communities, new parameters may be added to the analysis of ground and surface waters sampled by the program.

Laboratory Services in Knoxville, Tennessee will furnish sample containers. Samples will be collected using approved TDEC and EPA standard operating procedures for sampling. Vinyl exam gloves as well as the utilization of decontamination equipment and procedures will be necessary to

avoid cross contamination. Appropriate lab, field and trip blanks will be utilized and the division's sample coolers will be used to insure that samples are preserved in route to Laboratory Services.

DOE Coordination/Communication

Upon selection of sampling points DOE will be notified by contacting the manager for the DOE Environmental Management Groundwater Program. Ample notice will be given prior to sampling events to allow DOE the opportunity to observe or take split samples. Specific analytical results will be made available upon request.

All results and findings will be reported in the DOE-Oversight Division's Environmental Monitoring Report. It is anticipated there will be six sections in that report covering:

- offsite sampling results (private residential and non-community wells, and springs),
- onsite springs and monitoring wells,
- groundwater tracing,
- Chestnut Ridge Y-12 landfills,
- exit pathway investigations and,
- chlorinated solvent air impact from groundwater plumes (see: Appendix A)

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Tracing Studies on Chestnut Ridge

Introduction

Before 2002, sampling was carried out under a plan to monitor springs on a down gradient from the landfills, as well as under the division's previous groundwater monitoring plan. Prior to that time, there was no indication that the closed landfills impacted water quality in the springs (TDEC, 1994-2004). However, elevated levels of suspended solids in springs have been observed after rainfall, apparently due to current landfill operations and construction projects in the area. Since 2002, sampling of springs along the southeast-facing slope of Chestnut Ridge has been incorporated into the division's groundwater monitoring program. This was necessary to identify contaminant releases from solid waste landfills operated by the Y-12 Nuclear Weapons Facility.

The division sampling team concluded that numerous small sinking streams and sinkholes along Chestnut Ridge must feed these springs, but the basins have not been delineated and the sources of the sediment load in the springs have not been clearly identified. Therefore, the emphasis of this monitoring project has shifted from spring sampling to tracing groundwater flow-paths on the southeast slope of Chestnut Ridge. The highest priority for a tracing study is up stream of Greenbarn Spring (See Figure 1), which consistently shows high turbidity levels after storms. Other areas along Chestnut Ridge between White Oak Creek and Kerr Hollow Quarry are also potential locations for tracer studies.

Methods and Materials

Tracing will be conducted using fluorescent dyes (Smart and Laidlaw, 1977). Analytical work will be performed with a field fluorometer. This will be completed at a contract Laboratory Services that provides spectrofluorophotometric analyses. Dye amounts will be estimated using published equations for computing mass of dye (Worthington and Smart, 2003). Work will be conducted in accordance with the DOE Oversight *Health, Safety, and Security Plan,* updated 2004, other TDEC guidance and other procedures.

Coordination/Communication

Prior to commencing the trace, notice of the work to be done will be filed with the Division of Water Supply. DOE will be notified via e-mail and by written letter. Ample notice will be given to DOE to allow the opportunity to observe or take split samples. Analytical results will be made available upon request. All results and findings will be reported in the DOE Oversight Division's Environmental Monitoring Report. Traces will be documented with dye quantities, placement locations and monitoring locations.

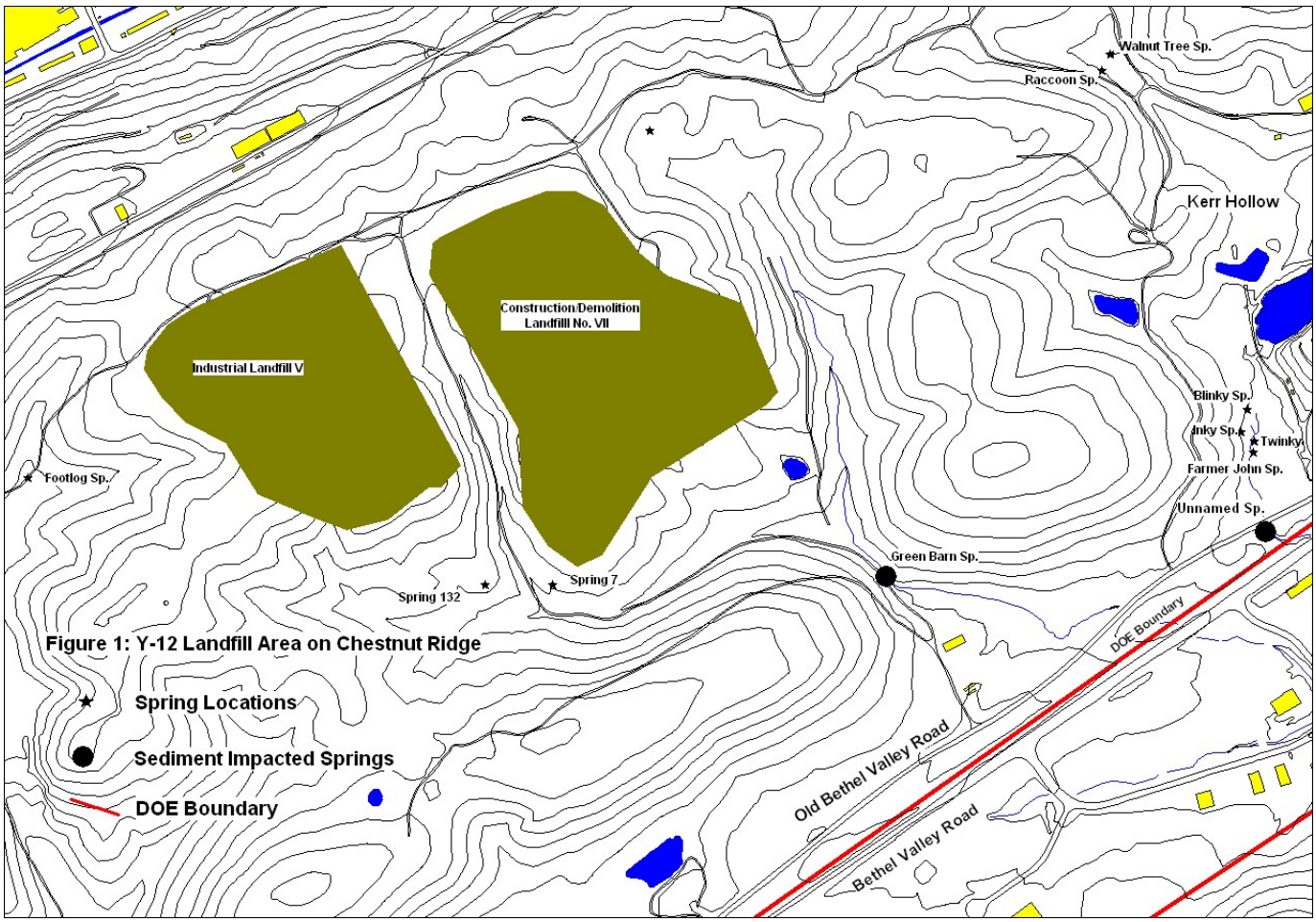

Figure 1: Y-12 Landfill Area on Chestnut Ridge

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RADIOLOGICAL MONITORING

Ambient Gamma Radiation Monitoring of the Uranium Hexafluoride (UF_6) Cylinder Yards at the East Tennessee Technology Park (a.k.a. K-25 Gaseous Diffusion Plant)

Introduction

The Tennessee Department of Environment and Conservation, Division of DOE Oversight (the division) plans to continue the use of environmental dosimeters to monitor radiation levels at the Uranium Hexafluoride (UF_6) Cylinder Storage Yards at the East Tennessee Technology Park (ETTP). The storage yards are currently being remediated and the cylinders moved to the Portsmouth Gaseous Diffusion Plant, where the UF_6 is to be converted into a form more suitable for use and/or disposal. The goal of this dose assessment program is to determine if the public is protected from radiation doses emitted from the cylinder yards, especially important since one DOE mission is to transform the East Tennessee Technology Park into a commercial industrial park. Monitoring performed in 2007 will primarily focus on establishing the post remediation dose levels. Once this is accomplished for all the storage yards, the project will be terminated. These measurements will be used to evaluate the effectiveness of the remediation and to provide a baseline for any future remedial activities at the sites (e.g., soil remediation).

The UF_6 contained in the cylinders is a by-product of the gaseous diffusion process previously used to enrich uranium at ETTP (a.k.a. the K-25 Gaseous Diffusion Plant). In past years, the radiation measured at the storage yards has consistently been among the highest reported in the division's gamma monitoring programs. In addition, the rusted and deteriorating cylinders (Figure 1) have posed a risk for the release of radioactive and toxic materials to the environment. As described by DOE's Office of Oversight in *Independent Investigation of the East Tennessee Technology Park* (DOE, 2000):

"*The depleted UF_6 cylinders at ETTP represent the worst case within the DOE complex (oldest cylinders, worst previous and current storage conditions, and largest number of previous breaches). Inspection of legacy depleted UF_6 cylinders at ETTP in 1991 and 1992 identified a number of cylinders with cylinder valve leakage and four cylinders with breached sidewalls, leakage, and ground contamination…. In 1998, a pinhole-size cylinder breach (probably associated with a weld defect) was discovered during initial refurbishment activities.*"

Figure 1: ETTP UF_6 Cylinders from *Independent Investigation of the East Tennessee Technology Park* (DOE, 2000)

In addition to the above, two factors, the presence of storage yards adjacent to Poplar Creek and that of workers not directly associated with DOE operations, increase the risk that members of the public could access the storage yards, exposing themselves to the associated hazards.

To remedy the problems, the state and DOE entered into a consent order in 1999 requiring the removal of the depleted UF_6 cylinders from ETTP by December 31, 2009. In 2004, DOE began shipping the cylinders to the Portsmouth Gaseous Diffusion Plant. To date, more than 5,800 of the 5,952 cylinders have been shipped to Portsmouth and four of the six cylinder yards have been emptied. As a result, the hazards associated with the storage yards have significantly decreased over the last few years.

Methods and Materials

As in the past, the division's monitoring at the UF_6 Cylinder Yards will be performed using Luxel® optically-stimulated luminescent dosimeters (OSLs) obtained from Landauer, Inc. of Glenwood, Illinois. These dosimeters use an aluminum oxide photon detector capable of measuring doses of gamma radiation ranging from 1 to 1,000 mrem.

The field dosimeters will be placed at selected monitoring locations along the perimeters of the cylinder yards. After three months, the dosimeters will be collected and shipped to the vendor (Landauer) for processing. When received, the results will be entered into a database and associated mapping software (MapInfo Professional Version 4.0.2®). Using this software, a map will be generated that provides the location of each of the monitoring stations (obtained by using the Global Positioning System) and the associated data for each. At the end of the year, the quarterly results will be summed for each of the monitoring stations and the resulting annual doses compared to the state and DOE primary dose limits for members of the public (100 mrem/year).

To account for exposures that occur during the storage and/or transport of the dosimeters, a control dosimeter will be included in each batch of OSLs received from Landauer. The control dosimeter will be stored in a lead container at the division's offices during the monitoring period, then returned with the associated field deployed dosimeters to the vendor for processing. Any dose detected by the control dosimeters will be subtracted by the vendor from the doses reported for the monitoring locations that were in the same batch.

A report presenting the data for the previous quarter will be prepared quarterly. This report will then be distributed to DOE, EPA, and other interested parties. In March of 2008, a report containing the 2007 results and associated findings will be prepared for inclusion and publication in the division's annual Environmental Monitoring Report.

References

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Landauer Service Guide. Landauer, Inc. Glenwood, Illinois. 1999.

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Facility Survey Program and Infrastructure Reduction Activity

Introduction

The Tennessee Department of Environment and Conservation's Department of Energy Oversight Division (the division), in cooperation with the U.S. Department of Energy and its contractors, operates a facility survey program (FSP) on the Oak Ridge Reservation (ORR). The division's survey program provides a comprehensive, independent characterization of facilities on the ORR based on several factors. Operational history, present mission and physical condition, inventories of radiological and/or hazardous materials, degree of contamination, contaminant release history, and potential for release of contaminants to the environment name a few.

The goal of the program is to fulfill portions of the commitments agreed to by the State of Tennessee and the U.S. Department of Energy in Section 1.2.3 of the *Tennessee Oversight Agreement,* which states that "Tennessee will pursue the initiatives in attachments A, C, E, F, and G. The general intent of these action items is to continue Tennessee's: (1) environmental monitoring, oversight and environmental restoration programs; (2) emergency preparedness programs; and (3) delivery of a better understanding to the local governments and the public of past and present operations on the ORR and potential impacts on the human health and/or environment by the Oak Ridge Reservation." As part of this larger endeavor, *the facility survey program is designed to provide a detailed assessment of all potential hazards affecting or in any way associated with facilities on the Oak Ridge Reservation.*

To meet this objective, survey team members walk through each facility and gather information, which is then recorded in a database. This information allows the team to characterize facilities and evaluate their potential for release of contaminants to the environment (PER). The conditions of facilities are considered according to a variety of environmental conditions ranging from catastrophic (i.e. tornado, earthquake) to normal everyday working situations. From an emergency preparedness perspective, such information is essential.

In 2002, the Department of Energy instituted a formal, accelerated decontamination and decommissioning (D&D) program aimed at facility reduction through demolition. Facility survey staff responded to this activity by making facility visits and walkthroughs of each facility prior to, and during, demolition. Information concerning the nature and destination of waste streams from the demolition sites is gathered and submitted to the division's Waste Management section. This activity will continue in 2007.

Methods and Materials

The criteria used in the selection of facilities to be surveyed include: 1) the position of the individual facility in S&M(surveillance & maintenance)/D&D programs; 2) the perceived physical condition of the facility; 3) the perceived levels of contamination; 4) the types or quantities of inventories (hazardous or radiological) and, 5) the special circumstances (incidents, public or other agency request, or other unforeseen situations).

Using standard radiation survey instruments, inventory data, and historical documentation, staff walk through each facility and record information on a questionnaire form. Based on the results of

the questionnaires and professional judgment, staff then rank the potential for release of contaminants to the environment (PER) for each facility by scoring 0 (least potential) to 5 (greatest potential) for each of 10 "categories." Tables 1 and 2 illustrate the scoring guidelines for potential environmental release, and the categories to be scored.

Table 1: Potential for Environmental Release Scoring Guidelines

Score	Score is based on observations in the field and the historic and present-day threat of contaminant release to the environment/building and/or ecological receptors.
0	No potential: no quantities of radiological or hazardous substances present.
1	Low potential: minimal quantities present, possibility of an insignificant release, very small probability of significant release, modern maintained containment.
2	Medium potential: radiological or hazardous substances present, structures stable in the near to long term, structures have integrity but are not state-of-the-art, adequate maintenance.
3	Medium potential: structures unstable, in disrepair, containment failure clearly dependent on time, integrity bad, maintenance lacking, containment exists for the short term only.
4	High potential: radiological or hazardous substances present. Containment for any period of time is questionable; migration to environment has not started.
5	Radiological or hazardous substance containment definitely breached, environmental/interior pollution from structures detected, radiological and/or hazardous substances in inappropriate places like sumps/drains/floors, release in progress, or radiological exposure rates above Nuclear Regulatory Commission (NRC) guidance.
Note: A score of 0 or 1 designates a low Potential Environmental Release rank; a score of 2 or 3 designates a moderate rank; a score of 4 or 5 designates a high rank.	

Table 2: Ten Categories Scored

1.	Sanitary lines, drains, septic systems
2.	Process tanks, lines, and pumps
3.	Liquid low-level waste tanks, lines, sumps, and pumps
4.	Floor drains and sumps
5.	Transferable radiological contamination
6.	Transferable hazardous materials contamination or waste
7.	Ventilation ducts and exit pathways capable of creating outdoor air pollution
8.	Ventilation ducts and indoor air/building contamination threat
9.	Escalated radiation exposure rates inside the facility
10.	Escalated radiation exposure rates outside the facility

As facilities are surveyed, scored, and compared with each other, a relative "potential for environmental release" will emerge. The facilities that show a high potential for release of contaminants will be noted in the program's annual report. Staff will revisit these facilities at their discretion to evaluate changing conditions. Table 3 provides a list of target facilities to be surveyed during the next year.

Table 3: Target Schedule of Facilities to be Surveyed *

ORNL		Y-12		K-25	
Facility	**Date**	**Facility**	**Date**	**Facility**	**Date**
X-3030	Jan. 15	Y-9720-19	Jan. 30	On demand	
X-3031	Feb. 15	Y-9720-19A	Feb. 15		
X-3032	Mar. 15	Y-9720-19B	April 15		
X-3033	May 15	Y-9404-9	June 15		
X-2001	June 15	Y-9720-6	Aug. 15		
X-2024	July 15	Y-9201-2	Oct. 15		
X-2011	Sept. 15	Y-1501-2	Nov. 1		
X-3508	Oct. 15				
On demand					

*** Facility numbers and dates are subject to change.**

References

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Yard, C.R. *Emergency Response Procedures Manual,* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee. 2005.

Haul Road Radiological Surveys

Introduction

The Tennessee Department of Environment and Conservation, Department of Energy Oversight Division (the division), with the cooperation of the U.S. Department of Energy and its contractors, will periodically perform walkover radiation surveys for the purpose of evaluating DOE property for re-use. The surveys will be conducted according to Section 120(h) of the CERCLA law process for establishing clean areas following direct guidelines. In addition, walkover surveys may be performed, as needed, in conjunction with other special projects or on-going activities.

Background of the Project

The project has incorporated the haul roads used by DOE for the transport of radiological waste on the reservation. Reeves Road and the new haul road (unnamed and connecting ETTP to EMWMF) are currently being monitored. Under a modified DOE Order 5400.5, any areas exceeding 200 dpm/100cm^2 removable beta, 1000 dpm/100cm^2 total beta, 20 dpm/100cm^2 removable alpha, and 100 dpm/100cm^2 total alpha would require remediation. These values are conservative based on the actual DOE Order 5400.5 for these contaminants. Of note, portions of the New Haul Road are high in shale, which is naturally higher in radioactive material. In addition to these two haul roads, other roads are surveyed on an interim basis as needed. Periodically non-haul roads become haul roads for a short duration of time, typically due to construction or some other activity that cannot be avoided. During the time these roads act as haul roads they will be surveyed by the state. A thorough beta-gamma scan will be performed as well.

Methods and Materials

The walkover surveys are conducted using a physical approach. Background material in the vicinity is evaluated prior to the survey by conducting a drive-through of the area. From there, a walkover survey of the area is conducted with the use of the division's radiological detection instruments. The instruments available for use are provided in Table 1.

Table 1: Division of DOE Oversight Portable Radiation Detection Equipment

Radiological Detection Instruments	Radiological Detection Probes	Radioactivity Measured
Ludlum Model 2221 Scaler Ratemeter	Ludlum Model 44-10 2X2" NaI Gamma Scintillator	Gamma (cpm)
Ludlum Model 3 Survey Meter	Ludlum Model 44-9 Pancake G-M Detector	Alpha, Beta, Gamma (cpm)
Ludlum Model 3 Survey Meter	Ludlum Model 43-65 50 cm^2 Alpha Scintillator	Alpha (cpm)
Bicron micro rem	Internal 1X1" NaI Gamma Scintillator	Tissue Dose Equivalent, Gamma (μrem/hr)
Bubble Technology Industries Microspec-2	E-probe with 2X2" NaI Gamma Scintillator	Gamma Spectroscopy (isotope identification)

The instrument of choice during most of the road surveys is the Ludlum Model 2221 Scaler Ratemeter with the Model 44-10 2" X 2" NaI Gamma Scintillator. Other radiological instruments are on hand if needed.

Two staff members conduct the haul road walkover survey. The staff members will visually split the road into halves. Each staff member will survey their half of the road. The probes will be held approximately six to twelve inches above the ground's surface. Each staff member will walk in a serpentine type motion from side to side along the portion of road they are surveying.

Areas with staining of soil or stressed vegetation are noted with the division's global positioning system device for sampling. When an area of concern is noted, staff conducts a thorough walkover of the area and uses the GPS to locate the area of concern by latitude and longitude coordinates. Areas of concern, as well as other points, are logged to show coverage. A map of the area is printed out with points of interest and/or concerns plotted. A report is generated with the state's findings. Concerns are brought to the attention of the Federal Facility Agreement Project Managers for resolution.

References

Environmental Restoration Footprint Reduction Process Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee.

Federal Facility Agreement, January 1992 (with revisions).

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

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Ambient Gamma Radiation Monitoring of the Oak Ridge Reservation Using Environmental Dosimetry

Introduction

Gamma radiation is emitted by various radionuclides that have been produced, stored, and disposed of on the Oak Ridge Reservation (ORR). Associated radionuclides are evident in ORR facilities and the surrounding soils, sediments, and waters. In order to assess the risk posed by these contaminants, the Tennessee Department of Environment and Conservation, DOE Oversight Division (the division) began monitoring ambient gamma radiation levels on the ORR in 1995. The program is intended to provide:

- conservative estimates of the potential dose/risk to members of the public from exposure to gamma radiation attributable to DOE activities/facilities on the ORR,
- baseline values used to assess the need/effectiveness of remedial actions,
- information necessary to establish trends in gamma radiation emissions and,
- information relative to the unplanned release of radioactive contaminants on the ORR.

In this effort, environmental dosimetry is used to measure the radiation dose attributable to external radiation at selected monitoring locations on and in the vicinity of ORR.

Methods and Materials

Dosimeters used in the program will be obtained from Landauer, Inc., Glenwood, Illinois. Each of these dosimeters will use aluminum oxide photon detectors to measure the dose from gamma radiation (minimum reporting value = 1 mrem). At locations where there is a potential for the release of neutron radiation, the dosimeters will also contain an allyl diglycol carbonate-based neutron detector (minimum reporting value = 10 mrem for thermal neutrons and 20 mrem for fast neutrons). Dosimeters that contain photon detectors alone will be collected quarterly and sent to Landauer for processing. Dosimeters that contain both photon and neutron detectors will be collected and processed semiannually, to better accommodate neutron measurements.

To account for exposures that may be received in transit or while in storage, control dosimeters will be included in each batch of dosimeters received from the Landauer Company. These dosimeters will be stored in a lead container at the division office during the monitoring period and returned to Landauer with the associated field-deployed dosimeters for processing. Any dose reported for the control dosimeters will then be subtracted from the dose reported for the field-deployed dosimeters. At the end of the year, the results will be summed for each location and the resultant annual doses compared to background values and the state/DOE primary dose limits for members of the public (100 mrem/year).

Monitoring locations will be chosen to identify sources of external radiation on the ORR, to develop conservative estimates of the dose to the public from DOE operations/facilities, and to collect information relative to the need and/or effectiveness of remediation. Candidate monitoring locations include operating facilities, areas on the ORR that are accessible to the public, sites at the perimeter of the reservation near known radiation sources, local communities and sites subject to or undergoing remediation. The location of sites currently monitored in the program are illustrated in Figure 1 and a short description of each site is provided in Table 1. In 2007, additional monitoring

stations are planned for the Spallation Neutron Source. Other monitoring locations may be added or removed as findings and/or changing conditions merit.

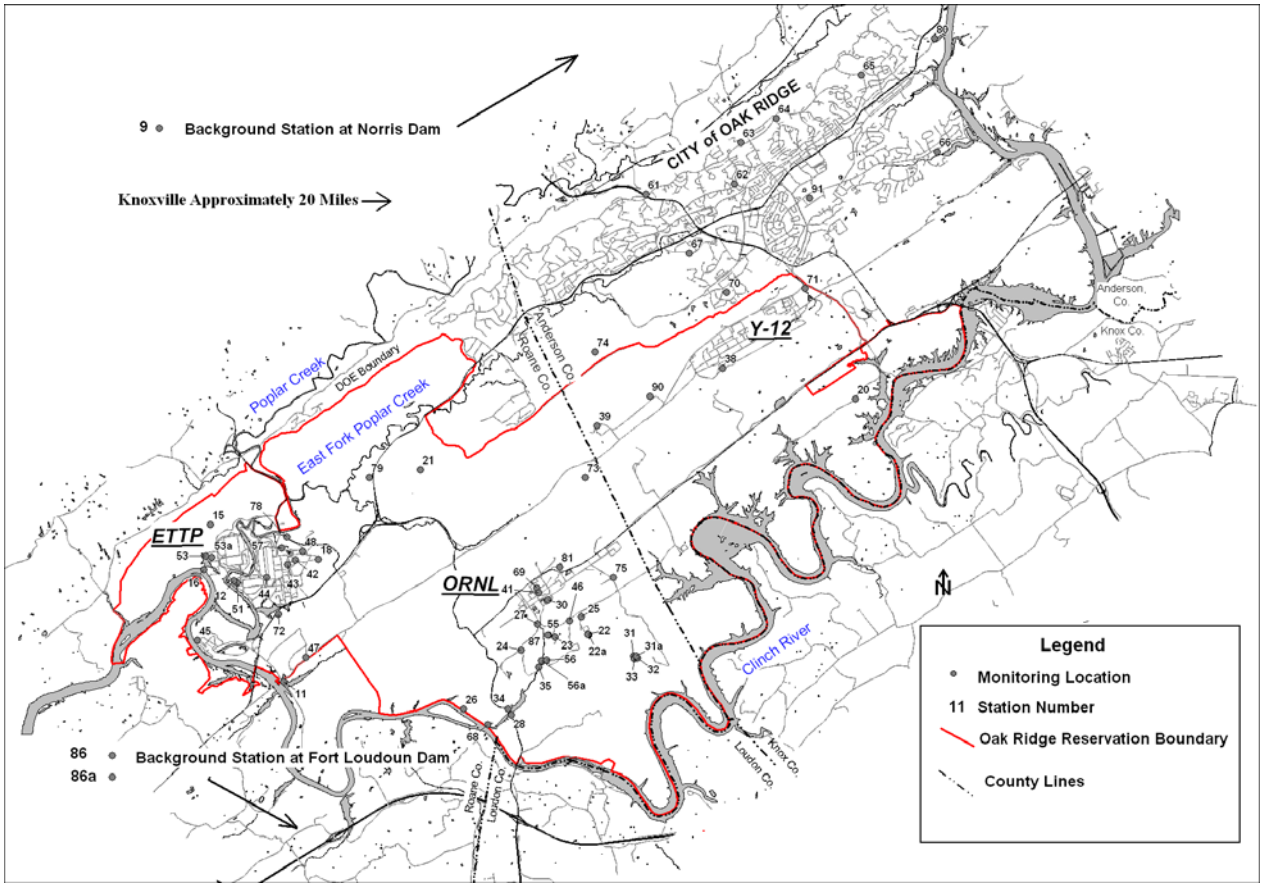

Figure 1: Locations of TDEC Environmental Dosimeters on/near the Oak Ridge Reservation

Table 1: Locations of Environmental Dosimeters Deployed on/near the Oak Ridge Reservation

Station Number (Dosimeter Type)	Location	Station Number (Dosimeter Type)	Location
9. (Photon)	Norris Dam Air Monitoring Station	48. (Photon)	Temp. 1: ETTP K-1420 Building
11. (Photon)	ETTP Grassy Creek Embayment on the Clinch River	51. (Neutron-Photon)	ETTP north side of the K-1066-E UF_6 Cylinder Storage Yard
12. (Neutron-Photon)	ETTP UF_6 Cylinder Yard K-1066-E	53. (Neutron-Photon)	ETTP southwest corner of the K-1066-K UF_6 Cylinder Storage Yard
15. (Photon)	ETTP K-1070-A Burial Ground	53a. (Neutron-Photon)	ETTP southwest corner of the K-1066-K UF_6 Cylinder Yard (duplicate)
16. (Photon)	ETTP K-901 Pond	55. (Photon)	Temp. 8: ORNL SWSA 5 TRU Trench
17. (Neutron-Photon)	ETTP K-1066-K UF_6 Cylinder Yard	56. (Photon)	Temp. 9: ORNL Old Hydrofracture Pond
18. (Photon)	ETTP TSCA on fence across from Tank Farm	56a. (Neutron-Photon)	ORNL Old Hydrofracture Pond (duplicate)
20. (Photon)	ORNL Freels Bend Entrance	57. (Photon)	Temp. 10: ETTP UF6 Cylinder Storage Yard K-1066-B
21. (Photon)	ETTP White Wing Scrap Yard	61. (Photon)	Temp. 14: Outer & Illinois Ave
22. (Photon)	ORNL High Flux Isotope Reactor	62. (Photon)	Temp. 15: East Pawley
22a. (Photon)	ORNL High Flux Isotope Reactor (duplicate)	63. (Photon)	Temp. 16: Key Springs Road
23. (Photon)	ORNL Solid Waste Storage Area 5	64. (Photon)	Temp. 17: Cedar Hill Greenway
24. (Photon)	ORNL Building X-7819	65. (Photon)	Temp. 18: California Ave.
25. (Photon)	ORNL Molten Salt Reactor Experiment	66. (Photon)	Temp. 19: Emory Valley Greenway
26. (Photon)	ORNL Cesium Fields	67. (Photon)	Temp. 20: West Vanderbilt
27. (Photon)	ORNL White Oak Creek Weir @ Lagoon Rd	68. (Photon)	White Oak Creek @ Coffer Dam
28. (Photon)	ORNL White Oak Dam	69. (Photon)	ORNL Graphite Reactor
30. (Photon)	ORNL X-3513 Impoundment	70. (Photon)	Scarboro Perimeter Air Monitoring Sta.
31. (Photon)	ORNL @ Cesium Forest boundary	71. (Photon)	Y-12 East Perimeter Air Monitoring Sta.
31a. (Photon)	ORNL @ Cesium Forest boundary (duplicate)	72. (Photon)	ETTP Visitors Center

Station Number (Dosimeter Type)	Location	Station Number (Dosimeter Type)	Location
32. (Photon)	ORNL Cesium Forest on tree	73. (Photon)	Temp. 3: ORNL Spallation Neutron Source (north side)
33. (Photon)	ORNL Cesium Forest Satellite Plot	74. (Photon)	Temp. 4: ORNL Spallation Neutron Source (south side)
34. (Photon)	ORNL SWSA 6 on fence @ Highway 95	75. (Photon)	Temp. 5: ORNL hot spot on Haw Ridge
35. (Photon)	ORNL confluence of White Oak Creek & Melton Branch	78. (Photon)	Temp. 11: ED3 Quarry at Blair Road
38. (Photon)	Y-12 Uranium Oxide Storage Vaults	79. (Photon)	Temp.12: ED1 on pole
39. (Photon)	Y-12 @ back side of Walk In Pits	80. (Photon)	Temp.13: Elza Gate
41. (Photon)	ORNL North Tank Farm	81. (Photon)	ORNL visitors center
42. (Photon)	ETTP east side of the K-1401 Building	86. (Photon)	Background at Ft. Loudoun Dam
43. (Photon)	ETTP west side of the K-1401 Building	86a. (Neutron-Photon)	Background at Ft. Loudoun Dam
44. (Photon)	ETTP K-25 Building	87. (Neutron-Photon)	ORNL SWSA 5
45. (Photon)	ETTP K-770 Scrap Yard	90. (Photon)	EMWMF
46. (Photon)	ORNL Homogeneous Reactor Experiment Site	91. (Photon)	Currently at the TDEC DOE-O office
47. (Photon)	Y-12 Bear Creek Road ~ 2800 feet from Clinch River		

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Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry (Environmental Applications), ANSI N545-1975, American National Standards Institute, 1975 (Revised 1982)

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Real Time Monitoring of Gamma Radiation on the Oak Ridge Reservation

Introduction

The Tennessee Department of Environment and Conservation, DOE Oversight Division (the division), in association with its Ambient Gamma Radiation Monitoring Program, has deployed continuously-recording exposure-rate monitors on the Oak Ridge Reservation since 1996. These instruments record gamma radiation levels at predetermined intervals for extended periods of time. The instruments have primarily been used to monitor remedial activities and supplement the integrated dose rates provided by environmental dosimeters. In this regard, the dosimeters provide a cumulative dose over the monitoring interval, but the data do not indicate the specific time and magnitude of fluctuations in the dose rates. Consequently, a series of small releases cannot be distinguished from a single large release using the dosimeters alone. In contrast, the exposure rate monitors provide a profile of gamma emissions that can be correlated with changing environmental and/or anthropogenic conditions.

Methods and Materials

The continuous exposure rate monitors used in the program incorporate detection equipment, power supply, software, and associated instrumentation in a portable weather resistant case. The units are capable of measuring and recording gamma exposure rates from 1 μrem/hr to 1 rem/hr at preset intervals of one minute to two hours over extended time periods (e.g., a year). The data can be downloaded in the field using an infrared transceiver, a lap top computer, and associated software.

Monitoring focuses on the measurement of exposure rates under conditions where gamma emissions are expected to fluctuate substantially over short time periods or where there is a potential for the unplanned release of gamma emitting radionuclides. The primary areas monitored in the program will be associated with remedial or waste management activities at sites where gamma radiation is known to be a concern. Sites currently monitored in the program (Figure 1) include:

- the scale located at the EMWMF entrance on Bear Creek Road,
- the scale located at the Portal 6 Haul Road which leads to EMWMF,
- the Corehole 8 Remedial Action at ORNL,
- the Molten Salt Reactor Experiment Remedial Action at ORNL,
- the TRU Waste Processing Facility in Melton Valley, and
- the background station located at Fort Loudoun Dam in Loudon County.

Monitoring stations can be expected to vary as the sites subject to remediation change and findings warrant. Additional candidates for monitoring in 2007 include the Spallation Neutron Source and the D&D of the K-25 Building.

To evaluate the exposure rates recorded, data collected from the monitoring sites will be compared to background concentrations, to the state limits for the maximum dose to an unrestricted area (2 mrem in any one hour period), and to the state/DOE primary dose limits for members of the public (100 mrem/year).

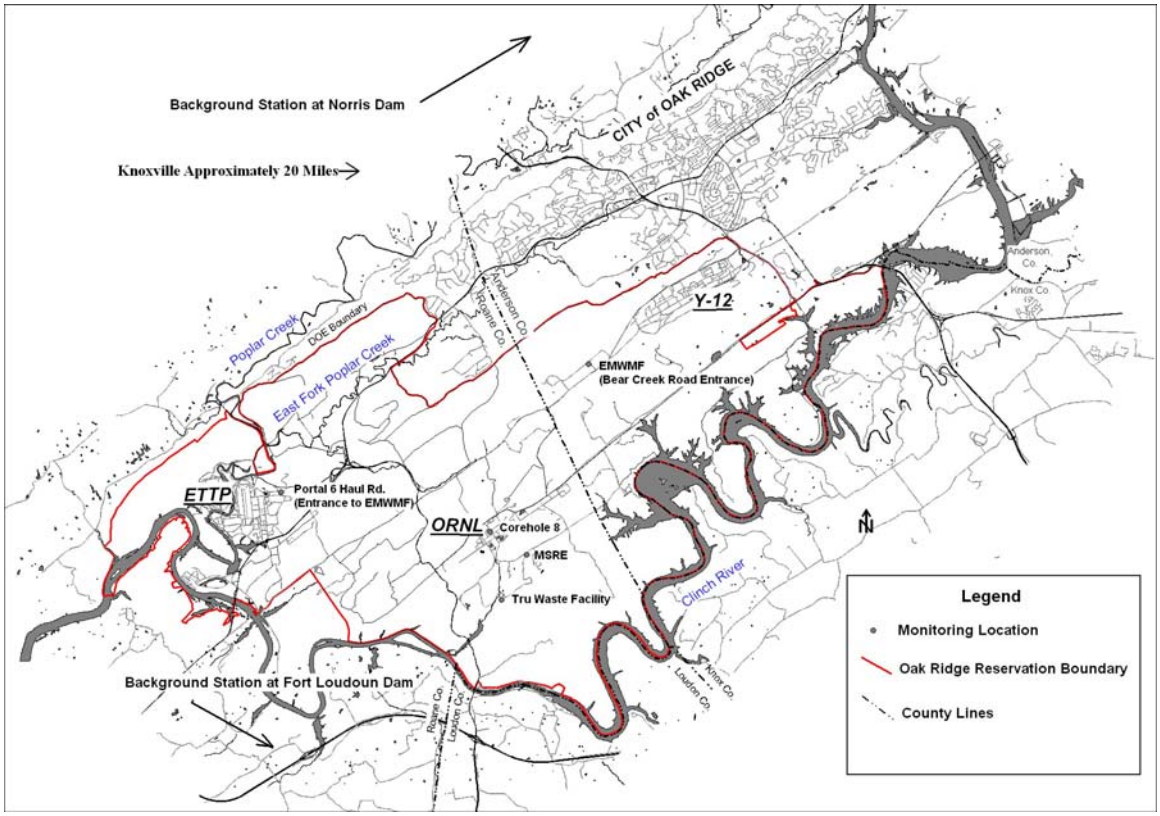

Figure 1: Current Location of TDEC Continuous Exposure Rate Monitors on the Oak Ridge Reservation.

References

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Surplus Material Verification

Introduction

Since 2002, the Tennessee Department of Environment and Conservation, Department of Energy Oversight Division (the division), in cooperation with the U.S. Department of Energy and its contractors, conducts random radiological surveys of surplus materials that are destined for sale to the public on the Oak Ridge Reservation (ORR). Standard radiological survey protocols are used for these radiological surveys. In addition to performing the surveys, the division reviews these procedures used for release of materials under DOE radiological regulations.

Also reviewed are any occurrence reports that involve surplus materials. Some materials, such as scrap metal, may be sold to the public under annual sales contracts, whereas other materials are staged at various sites around the ORR awaiting public auction/sale. The division, as part of its larger radiological monitoring role on the reservation, conducts these surveys to help ensure that no potentially contaminated materials reach the public. In the event that radiological activity is detected, the division will immediately report to the responsible supervisory personnel of the surplus sales program. We will follow their response to the notification, ensuring that appropriate steps (removal of items from sale, resurveys, etc.) are taken to protect the public. The division reviews any occurrence reports, procedural changes and removal of items from sales inventories.

Methods and Materials

Staff members make random surveys of items that are arranged in sales lots by using standard survey instruments and standard survey protocols. Potential items range from furniture and computer equipment to vehicles and construction materials. Particular survey attention is paid to smaller equipment and parts. Where radiological release information is attached, radiation clearance information is compared to procedural requirements. If any contamination is detected during the on-site survey, the surplus materials manager for the facility will be notified immediately. In addition to radioactivity, any chemical concerns will be immediately brought to the attention of the manager.

References

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

Thomasson, D.A., *Health, Safety, and Security Plan.* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee, 2004

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SURFACE WATER MONITORING

Monitoring of Liquid Effluents at the Environmental Management Waste Management Facility

Introduction

The Tennessee Oversight Agreement requires the state to provide monitoring as necessary to verify DOE data and to assess the effectiveness of DOE contaminant control systems on the Oak Ridge Reservation (ORR). To this end, TDEC's Division of DOE Oversight will monitor effluents, sediments, and biota at DOE's Environmental Management Waste Management Facility (EMWMF), located in eastern Bear Creek Valley. This facility was constructed to dispose of waste generated by remedial activities on the ORR and is operated under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). While the facility holds no permit from any state agency, it is required to comply with substantive portions of relevant and appropriate legislation contained in the CERCLA Record of Decision (DOE, 1999) and with requirements associated with responsibilities delegated to the DOE by the Atomic Energy Act.

While the availability of the EMWMF has expedited remedial activities, the water-rich environment of the region presents challenges to the containment of contaminants that would not be expected in more arid areas. For example, the height of the groundwater table, the quantity of surface water runoff, and the porosity of local soils were apparently underestimated in the planning stages of the facility. This resulted in repairs and/or operational modifications to maintain control of contaminant releases. One such modification triggered the excavation of a French drain under the facility to lower the water table, which had risen to levels that approached the liner of the facility.

Another modification requires the routine removal of liquids pooled over what should have been a porous layer emplaced to protect the leachate collection system and liner from being damaged during disposal operations. In the past, the pooling liquids have overflowed cell containment and discharged to the local environment. The liquid, a mixture of rainwater runoff and drainage from the waste, is now pumped to holding ponds, where it is sampled and then released to a ditch that empties into the sediment basin. The sediment basin discharges to a local tributary of Bear Creek (NT-5). It is the intent of the project to verify that effluents from the facility and associated contaminant control mechanisms are consistent with criteria agreed to by the state, EPA, and DOE.

Methods and Materials

Monitoring locations are depicted in Figure 1 and descriptions of the sampling points are provided below. (NT-# designates a numbered north tributary.)

- EMWMF 1: The background location (i.e. Catty Wampus Spring) located upslope of the facility at the headwaters of NT-4. The major portion of the NT-4 channel was filled and associated waters diverted to NT-5 to accommodate construction of the EMWMF.
- EMWMF 2: Discharge from a French drain emplaced under the facility to prevent groundwater from encroaching on the liner.

- EMWMF 3: The sediment basin at the outfall to NT-5.
- EMWMF 4: An unlined drain receiving storm water runoff from cells that are designated as inactive, but contain stored materials assumed to be waste.
- EMWMF 5: An unlined ditch used to transfer effluents from the holding ponds to the sediment basin. The effluents in the ponds consist of liquids and suspended materials that accumulate at the lower end of the active cell over the problematic protective soil cover.
- Other locations as merited.

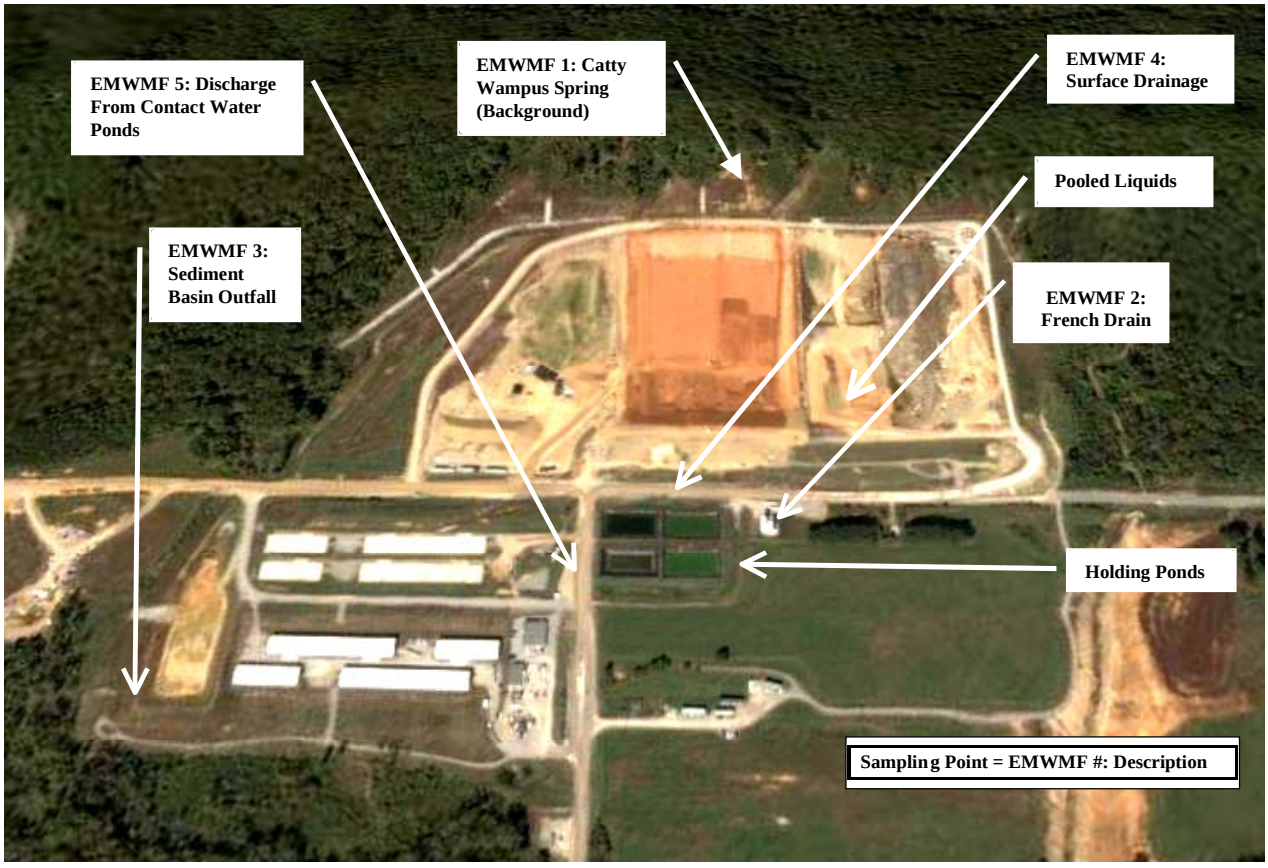

Figure 1: Sampling Locations at the Environmental Management Waste Management Facility

The media sampled is to include effluents, sediments, and biota. The analyses will vary based on the media being sampled, previous findings, and the particular wastes being disposed of. Since monitoring for all radionuclides disposed of in the facility would be cost prohibitive, initial efforts will focus specific analyses on the more mobile species (e.g. tritium and technetium-99), contaminants previously detected in effluents (e.g. uranium isotopes and strontium-90), and radionuclides that would not be evident in gross measurements (e.g. tritium and carbon-14). Gamma spectrometry will be used to identify gamma emitters (e.g. cesium-137). Gross analysis will be used to screen for alpha and beta emitters, with more specific analyses performed in response to elevated results.

Sampling frequencies will depend on conditions and activities at the site. In general, concentrations of contaminants will fluctuate as site conditions change. The weather (precipitation), operational activities (pumping effluents from the holding ponds), and contaminants in the waste being disposed of, each effect contaminant concentrations. Consequently, samples will be taken as conditions merit with the intent to monitor waste streams under different conditions in order to characterize and delineate contaminant releases.

References

Record of Decision for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Waste, DOE/OR/01-1791&D3, U.S. Department of Energy, *Oak Ridge, Tennessee*. November 1999.

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

Thomason, D. A. Health, Safety, and Security Plan. Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee. 2004.

Rain Event Surface Water Monitoring

Introduction

Heavy rainfall events have the capability of transporting significant quantities of contaminants, which would normally remain in place, into nearby bodies of water. This mass transport can, in turn, impact the quality of the receiving waters. Due to the presence of areas of extensive point and non-point source contamination on the Oak Ridge Reservation (ORR), there exists the potential for contamination to impact surface waters on the ORR during excessive rain events. These events could cause the displacement of contamination that would not normally impact streams around the ORR.

To assess the degree of surface water impact caused by these rain events, a sampling of streams will be conducted following heavy rain events to determine the presence or absence of contaminants of concern. Table 1 shows locations that have been selected for sampling.

Table 1: Sample Locations

Site	Location
EFK 23.4	Station 17
WCK 3.0	White Oak Creek at Lagoon Road
MEK 0.1	Melton Branch Weir*
MIK 0.1	Mitchell Branch Weir
BCK 4.5	Bear Creek Weir at Hwy. 95
MBK 1.6	Mill Branch (Reference)

*an engineered structure that simplifies water flow measurement

Methods and Materials

In addition to temperature, pH, and conductivity, the following parameters will be measured:

Inorganics: arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, zinc, nitrogen (NO_2 & NO_3), ammonia, nitrogen (total Kjeldahl), total phosphates.

Other tests: E. coli, Enterococcus, dissolved residue, suspended residue, and total hardness.

Radionuclides: Gross alpha, gross beta, gamma radionuclides, and Strontium-90 (MEK 0.1 only).

Schedule

The monitoring will be conducted no more than once per quarter following either a one-inch rain event in a 24-hour period or a two-inch rain event over a 72-hour period.

Standard Operating Procedures

Special care must be taken when sampling water in which contaminants can be detected in the parts- per-billion and/or parts-per-trillion ranges. In order to prevent cross-contamination of these samples, the following precautions shall be taken when trace contaminants are of concern:

- A clean pair of new, non-powdered, disposable latex or vinyl gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come into contact with the media being sampled.

- Sample containers for source samples or for samples suspected of containing high concentrations of contaminants should be placed in separate plastic bags immediately after collecting, tagging, etc.

- If possible, different field teams should collect ambient samples and source samples. If different field teams cannot be used, all ambient samples shall be collected first and placed in separate ice chests or shipping containers. Samples of waste or highly-contaminated samples shall never be placed in the same ice chest as environmental samples. Ice chests or shipping containers for source samples or samples suspected to contain high concentrations of contaminants should be lined with new, clean, plastic bags.

- If possible, one member of the field sampling team should take all the notes, fill out tags, etc., while the other members collect the samples.

- When sampling surface waters, the water sample should always be collected before the sediment sample is collected.

- Sample collection activities should proceed progressively from the least suspected contaminated area to the most suspected contaminated area.

- Investigators should use equipment constructed of Teflon®, stainless steel, or glass that has been properly pre-cleaned when collecting samples for trace metals or organic compound analyses. Teflon® or glass is preferred where trace metals are of concern.

Sample Handling

After collection, all sample handling should be minimized. Investigators should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, investigators should ensure that melted ice cannot cause the sample containers to become submerged, as this may result in sample cross-contamination. Plastic bags, such as zip-lock bags or similar plastic bags sealed with tape, should be used when small sample containers (e.g., VOC vials or bacterial samples) are placed in ice chests. This will prevent cross-contamination.

Laboratory Services Procedures

Laboratory Services has expertise in a broad scope of services and analyses. This expertise is available to the Tennessee Department of Environment and Conservation, Department of Energy Oversight Division (the division) and other TDEC divisions statewide. General sampling and analysis methods will follow Environmental Protection Agency (EPA) guidelines as listed in appropriate parts of Title 40 Code of Federal Regulations (CFR). Laboratory Services may subcontract certain analyses and QC samples out to independent laboratories. Bench level quality

assurance/quality control (QA/QC) records and chain-of-custody records are maintained at Laboratory Services, as are QA records on subcontracted samples.

The division will primarily use the Knoxville branch of Laboratory Services. Wet chemistry and metals samples will be analyzed in Knoxville, while organics samples will be sent on to the Laboratory Services in Nashville. All Laboratory Services analyses will follow appropriate methods as documented in the Laboratory Services Inorganic Chemistry SOP and Organic Chemistry SOP. Specific analytical methods are covered in the Standard Operating Procedures (SOP) manuals for Laboratory Services. The SOPs direct analysts to the proper EPA or other methodology.

References

Environmental Compliance Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region IV, Environmental Services Division, Atlanta, Georgia. 1991.

Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region IV, 960 College Station Road, Athens, Georgia. 1996.

Standard Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing, E 1391-90, American Society for Testing and Materials, Philadelphia, PA, 1990.

Standard Operating Procedures, Tennessee Department of Health Laboratory Services Services, Nashville, Tennessee, 1999

The Status of Water Quality in Tennessee: Technical Report, Tennessee Department of Environment and Conservation, Division of Water Pollution Control. Nashville, Tennessee. 1998.

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation. Oak Ridge, Tennessee. 2006.

Thomasson, D. A. *Health, Safety, and Security Plan.* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee. 2004.

Ambient Sediment Monitoring

Introduction

Sediment samples are collected annually at various sites on the Clinch River and some of its tributaries. The sediment samples are analyzed for organics, metals, and radiological contamination in order to assess the sediment quality for public health and ecological considerations.

The objective of this monitoring program is to assess the degree of sediment pollution in the Clinch River and its tributaries. Sample locations are shown in Table 1.

Table 1: Sample Locations

Site	Location	Clinch River Mile*
2	Clinch River	52.6
3	Clinch River	35.5
4	Clinch River	17.9
5	Clinch River	10.1
6	Clinch River	48.7
7	Clinch River	41.2
8	Scarboro Creek (SCM 0.1)	41.2
9	Kerr Hollow Branch (KHM 0.1)	41.2
10	McCoy Branch (MCM 0.1)	37.5
12	East Fork Walker Branch (EFWM 0.1)	33.2
13	Bearden Creek (BCM 0.1)	31.8
18	Raccoon Creek (RCM 0.1)	19.5
20	Grassy Creek (GCM 0.1)	14.55
22	Unnamed stream (U22M 0.1)	14.45
23	Ernie's Creek (ECM 0.1)	51.1
24	White Creek (WCM 0.1)	102.4
25	Clear Creek (CCM 0.1)	78.2
27	Clinch River	7.0
28	Clinch River	4.0
29	Clinch River Mouth	0.0
32	Clinch River	19.7
33	Poplar Creek (PCM 1.0)	12.0
36	Poplar Creek (PCM 2.2)	12.0
37	Poplar Creek (PCM 3.5)	12.0
38	Poplar Creek (PCM 5.5)	12.0

*Clinch River Mile Column refers to location of stream mouth for tributaries.

Methods and Materials

Parameters to be analyzed:

> *Inorganics:* aluminum, arsenic, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, and zinc

Organics (extractables): butylbenzylphthalate, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, di-n-octylphthalate, diethylphthalate, dimethylphthalate, n-nitrosodimethylamine, n-nitrosodiphenylamine, n-nitroso-di-n-propylamine, isophorone, nitrobenzene, 2,4-dinitrotoluene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, bis(2-chloroethyl) ether, bis(2-chloroethoxy)methane, bis(2-chloroisopropyl) ether, 4-bromophenylphenyl ether, 4-chlorophenylphenylether, hexachlorocyclopentadiene, hexachlorobutadiene, hexachlorobenzene, hexachloroethane, 1,2,4-trichlorobenzene, 2-chloronapthalene, 4-chloro-3-methyl phenol, 2-chlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 4,6-dinitro-o-cresol, 2-nitrophenol, 4-nitrophenol, pentachlorophenol, phenol, 2,4,6-trichlorophenol

Organics (pesticides/PCBs): aldrin, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC (lindane), technical chlordane, alpha-chlordane, gamma-chlordane, 4,4-DDD, 4,4-DDE, 4,4-DDT, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, endrin ketone, heptachlor, heptachlor epoxide, toxaphene, methoxychlor, PCB 1016/1242, PCB 1221, PCB 1232, PCB 1248, PCB 1254, PCB 1260, PCB 1262

Radiological: gross alpha (total), gross beta (total), gamma radionuclides*:* ^{137}Cs, ^{40}K, ^{214}Pb, ^{214}Bi, ^{212}Pb, ^{228}Ac, ^{208}Tl, ^{212}Bi and others as detected.

Toxicity: Hyalella azteca 10-day sediment acute toxicity tests for impacted sites (10 samples)

Schedule

The ambient sediment monitoring will be conducted in the second quarter of 2007.

Sediment Standard Operating Procedures

Sediment analysis is a key component of environmental quality and impact assessment for rivers, streams, lakes, and impoundments. Samples can be collected for a variety of chemical, physical, toxicological and biological investigations. The procedures used by the division obtain quality-assured sediment sampling. The resulting data may be qualitative or quantitative in nature and is appropriate for use in preliminary surveys as well as confirmatory sampling.

Required Equipment

sampling platform/boat	aluminum foil	rubber gloves
depth finder	sample jars	field notebook
stainless steel petite ponar grab sampler	sample labels	chain-of-custody forms
stainless steel mixing bowl	cooler/ice packs	deionized water
stainless steel spoon	scrubber	
pressurized water sprayer	lab sheets	

Procedure

If the water is wadeable, one can collect a sediment sample by scooping the sediment using a stainless steel spoon or scoop. This can be accomplished by wading into the stream, and, while

facing upstream, scooping the sample along the stream bottom in the upstream direction. If one is sampling a deep lake or impoundment, one can use the Petite Ponar dredge to obtain a sample. Step-by-step directions are as follows:

Sediment sampling in wadeable streams and rivers

1. Locate suitable sampling site. Remember that a site immediately downstream of a riffle area has the greatest amount of deposition since the velocity of the stream slows down in these areas. Beware of constrictions in the stream where scouring (flow is so fast, no sediment can be deposited) may be occurring.
2. Don rubber gloves to avoid self-contamination during sampling.
3. Using a decontaminated stainless steel spoon, obtain sediment samples by scraping the streambed.
4. Place sufficient amount of sediment samples in a stainless steel bowl and mix thoroughly to obtain a homogeneous sample.
5. Carefully transfer sample into the appropriate container as stated by the environmental lab.
6. Record all pertinent information on lab sheets, sample labels, and in field notebook.
7. Place all samples into cooler as soon as possible. Temperature within the cooler should be maintained at 4° C by using ice or freezer packs.
8. Deliver sediment samples to environmental lab within appropriate time frames, and sign chain-of-custody forms.

Sediment sampling in lakes or reservoirs using Petite Ponar dredge

1. Don rubber gloves to avoid self-contamination during sediment sampling.
2. Place stabilizing pin into arm attachments to lock dredge jaws in open position.
3. Using dredge cable, carefully lower dredge through water column. Slow the descent just prior to contact with sediment to prevent any disturbance to the sediment.
4. As the dredge contacts the sediment, allow the line to go slack, which in turn releases the stabilizing pin.
5. Give a quick tug to the cable; this enables the dredge jaws to close. Carefully pull the dredge through the water column.
6. Repeat step 5 until sufficient sediment has been obtained, placing sediment into a stainless steel bowl.
7. Thoroughly mix the sediment samples with a stainless steel spoon to obtain a homogeneous composite.
8. Carefully transfer the collected sediment into appropriate sampling jars as directed by the environmental lab.
9. Record all pertinent information on lab sheets, samples labels, and in field notebook.
10. Place sediment samples into cooler as soon as possible. Temperature within the cooler should be maintained at 4^{o} C by using ice or freezer packs.
11. Deliver samples to environmental lab within appropriate time frames. Be sure to sign all chain of custody forms.

Laboratory Services Procedures

Laboratory Services has expertise in a broad scope of services and analyses available to the Tennessee Department of Environment and Conservation (TDEC) Department of Energy Oversight (the division) and other TDEC divisions statewide. General sampling and analysis methods will

follow Environmental Protection Agency (EPA) guidelines as listed in appropriate parts of Title 40 Code of Federal Regulations (CFR). Laboratory Services may subcontract certain analyses and QC samples out to independent laboratories. Bench level quality assurance/quality control (QA/QC) records and chain-of-custody records are maintained at Laboratory Services site, as are QA records on subcontracted samples.

The division will primarily use the Knoxville branch of Laboratory Services. Wet chemistry and metals samples will be analyzed in Knoxville while organics samples will be sent on to Laboratory Services in Nashville. All Laboratory Services analyses will follow appropriate methods as documented in the Laboratory Services Inorganic Chemistry SOP and Organic Chemistry SOP. Specific analytical methods are covered in the Standard Operating Procedures (SOP) manuals for Laboratory Services. The SOPs direct analysts to the proper methodology (e.g. EPA).

References

Environmental Compliance Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region 4, Environmental Services Division, Atlanta, Georgia. 1991.

Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual, EPA 823-B-01-002, U.S. Environmental Protection Agency, Office of Water. Washington, DC. 2001.

Standard Operating Procedures, Tennessee Department of Environment and Conservation, Department of Energy Oversight. Oak Ridge, Tennessee 1996.

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

Thomasson, D. A. *Health, Safety, and Security Plan.* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee. 2004.

Ambient Surface Water Monitoring

Introduction

Surface water sampling is conducted twice a year at 20 sites located on the Clinch River and its tributaries. The surface water samples are analyzed for radiological activity, metals, nutrients and other parameters in order to assess the water quality for public health and ecological considerations. Sampling sites 1, 2, 24, and 25 (noted in Table 1 below) are background data collection sites and are located upstream of the Oak Ridge Reservation (ORR). The other sites were chosen to detect contaminants being transported by surface water or stormwater coming from the ORR or from areas affected by Department of Energy (DOE)-related activities. TDEC personnel collect tributary samples far enough upstream such that high river levels do not compromise the sample.

Table 1: Sample Locations

Site	Location	Clinch River Mile*
1	Clinch River	78.7
2	Clinch River	52.6
3	Clinch River	35.5
4	Clinch River	17.9
5	Clinch River	10.1
6	Clinch River	48.7
7	Clinch River	41.2
8	Scarboro Creek (SCM 0.1)	41.2
9	Kerr Hollow Branch (KHM 0.1)	41.2
10	McCoy Branch (MCM 0.1)	37.5
12	East Fork Walker Branch (EFWM 0.1)	33.2
13	Bearden Creek (BCM 0.1)	31.8
18	Raccoon Creek (RCM 0.1)	19.5
20	Grassy Creek (GCM 0.1)	14.55
22	Unnamed Stream (U22M 0.1)	14.45
23	Ernie's Creek (ECM 0.1)	51.1
24	White Creek (WCM 0.1)	102.4
25	Clear Creek (CCM 0.1)	77.7
32	Clinch River	19.7
33	Poplar Creek (PCM 1.0)	12.0

*For tributaries, the Clinch River Mile column refers to the mouth of the tributary.

Methods and Materials

Parameters to be analyzed:

> *Inorganics:* arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, zinc, nitrogen (NO_2 & NO_3), ammonia, nitrogen (total Kjeldahl), total phosphorus.*Other tests: E. coli*, *Enterococcus*, COD, dissolved residue, suspended residue, total hardness.

Schedule
The ambient water monitoring will be conducted in the second and fourth quarters of 2007.

Standard Operating Procedures
Special care must be taken when sampling water in which contaminants can be detected in the parts-per-billion and/or parts-per-trillion ranges. In order to prevent cross-contamination of these samples, the following precautions shall be taken when trace contaminants are of concern:

- A clean pair of new, non-powdered, disposable vinyl gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come into contact with the media being sampled.

- Sample containers for source samples or for samples suspected of containing high concentrations of contaminants should be placed in separate plastic bags immediately after collecting, tagging, etc.

- If possible, one member of the field sampling team should take all the notes, fill out tags, etc., while the other member(s) collect the samples.

- When sampling surface waters, the water sample should always be collected before the sediment sample is collected.

- Sample collection activities should proceed progressively from the least suspected contaminated area to the most suspected contaminated area.

- Investigators should use equipment constructed of Teflon®, stainless steel, or glass that has been properly pre-cleaned for collecting samples to analyze for trace metals or organic compounds analyses. Teflon or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC shall not be used to collect samples for trace organic compounds analyses. These particular components could possibly contaminate samples.

Sample Handling
After collection, all sample handling should be minimized. Investigators should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, investigators should ensure that the sample containers will not become submerged by melted ice, as this may result in sample cross-contamination. Plastic bags, such as zip-lock bags or similar plastic bags sealed with tape, should be used when small sample containers (e.g., VOC vials or bacterial samples) are placed in ice chests. This will prevent cross-contamination.

Laboratory Services Procedures
Laboratory Services has expertise in a broad scope of services and analyses available to the Tennessee Department of Environment and Conservation, Department of Energy

Oversight Division (the division) and other TDEC divisions statewide. General sampling and analysis methods will follow Environmental Protection Agency (EPA) guidelines as listed in appropriate portions of Title 40 Code of Federal Regulations (CFR). Laboratory Services may subcontract out certain analyses and QC samples to independent laboratories. Bench level quality assurance/quality control (QA/QC) records and chain-of-custody records are maintained at Laboratory Services, as are QA records on subcontracted samples.

The division will primarily use the Knoxville branch of Laboratory Services. Wet chemistry and metals samples will be analyzed in Knoxville while organics samples will be sent on to Laboratory Services in Nashville. All Laboratory Services analyses will follow appropriate methods as documented in the Laboratory Services Inorganic Chemistry SOP and Organic Chemistry SOP. Specific analytical methods are covered in the Standard Operating Procedures (SOP) manuals for Laboratory Services. The SOPs direct analysts to the proper EPA or other methodology.

References

Environmental Compliance Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region 4, Environmental Services Division, Atlanta, Georgia. 1991.

Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, *EISOPQAM,* U. S. Environmental Protection Agency, Region 4, Enforcement and Investigations Branch, Athens, Georgia. 1997.

Hargrave, B.T., N.M. Burns, *Assessment of Sediment Trap Collection Efficiency,* Limnology and Oceanography 24 (6): 1124-1136.

Methods for Collection, Storage, and Manipulation of Sediments for 1Chemical and Toxicological Analyses: Technical Manual, EPA 823-B-01-002, U.S. Environmental Protection Agency, Office of Water. Washington, DC. 2001.

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Thomasson, D. A. *Health, Safety, and Security Plan.* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee. 2004.

Surface Water (Physical Parameters) Environmental Monitoring

Introduction

Due to the presence of areas containing extensive point and non-point source contamination on the Oak Ridge Reservation (ORR), there exists the potential for contamination that will impact surface waters on the ORR. This type of event could cause the displacement of contamination that would not normally impact streams around the ORR.

To assess the degree of surface water impact relative to this potential contamination displacement, real-time stream monitoring data will be collected twice a week during 2007 from a sitewide network of primary ambient monitoring stations. This will establish a database of physical stream parameters (i.e., conductivity, pH, temperature, dissolved oxygen, etc.). Watersheds to be monitored include East Fork Poplar Creek, Bear Creek and Mitchell Branch. The primary objective of this monitoring project is to provide supplementary water quality data for division programs in addition to other organizations outside of TDEC. Furthermore, this monitoring task is directed toward determining long-term water quality trends, assessing attainment of water quality standards and providing additional baseline data for evaluating stream recovery. Table 1 depicts a list of eight monitoring sites that have been selected for data collection. The BCK 9.0 (new weir) site is a new monitoring location for 2007.

Table 1: Sample Locations

Site	Location
EFK 23.4	Station 17
EFK 13.8	Oak Ridge Sewage Treatment Plant
BCK 4.5	Bear Creek Weir at Hwy. 95
BCK 9.0 (New Weir)	Bear Creek Monitoring Location
BCK 9.6	Bear Creek Monitoring Location
BCK 12.3	Bear Creek Monitoring Location
MIK 0.1	Mitchell Branch Weir
MBK 1.6	Mill Branch (Reference)

Methods and Materials

Surface water physical parameters to be collected semi-weekly at the eight sites include dissolved oxygen (DO), pH, temperature and conductivity. Three watersheds will be monitored at several sites. Samples will be taken at two sites at the Mitchell Branch watershed (East Tennessee Technology Park), two sites at the East Fork of the Poplar Creek watershed (Y-12 National Security Complex), and four sites at the Bear Creek watershed (Y-12 National Security Complex).

Data will be collected twice a month at each of the monitoring sites listed in Table 1. It is estimated that approximately three hours per field trip will be required to collect data at all eight monitoring sites.

The instrument to be used for the project is the Horiba U-10® Water Quality Checker (LCD readout). This state-of-the-art hand-held instrument is used for simultaneous multi-parameter measurement of

water quality. It measures the following: pH, conductivity, turbidity, dissolved oxygen, temperature, and salinity. The instrument consists of a probe unit (with various sensors) attached by a 3-foot cable to a handheld unit with a LCD readout and keypad. Measurements are taken simply by immersing the probe directly into the creek, pond, or river. Parameter readings can then be recorded from the hand-held unit LCD readout. One parameter at a time is displayed, initialized by using the keypad.

In the event that real-time field readings such as pH and conductivity are beyond benchmark ranges, then staff will wait 24 hours, re-calibrate the Horiba™ instrument, and re-take physical parameter readings. If readings are still deviant, staff will investigate possible causes (e.g., defective equipment, storm surge/rain events, releases that may have affected pH, etc.). Following their investigation, the findings will be reported to appropriate program(s) within the division to determine if further action is needed.

Standard Operating Procedures

Special care must be taken when monitoring water in which contaminants can be detected in the parts-per-billion and/or parts-per-trillion ranges. Also, proper maintenance and care of the Horiba U-10 instrument is essential. The instrument should be recalibrated regularly. In order to prevent or minimize cross-contamination and to extend the life of the monitoring instrument, the following precautions are recommended as QA/QC procedures:

- The Horiba U-10 instrument should be recalibrated prior to going to the field each week, and this data should be logged into the laboratory notebook.
- After instrument readings have been recorded at each monitoring station, the instrument probe should be rinsed and cleaned three times with deionized water before being used at the next monitoring site.
- The instrument probe parts should be thoroughly rinsed and cleaned prior to storage (after returning from each field outing). The Horiba U-10 owners manual specifies that the pH sensor must always be kept moist during long term storage; also, remove the battery from the main unit prior to long-term storage.
- If possible, one member of the field sampling team should take all the notes, fill out forms, etc., while the other member collects the field data using the Horiba U-10 instrument.
- Sample collection activities should proceed progressively from the least suspected contaminated area to the most suspected contaminated area.

Sample Handling

No water quality samples are needed for this project.

References

Horiba Water Quality Checker: Model U-10 Instruction Manual, 2nd edition, Horiba, Ltd., Miyanohigashi, Kisshoin, Minami-ku, Kyoto, Japan, November 1991.

The Status of Water Quality in Tennessee: Technical Report. Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Nashville, Tennessee. 1998.

Tennessee Oversight Agreement, Agreement Between the U.S. Department of Energy and the State of Tennessee, Tennessee Department of Environment and Conservation, Oak Ridge, Tennessee. 2006.

Thomasson, D. A. *Health, Safety, and Security Plan,* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee. 2004

Underwater Survey

Introduction

Historical operations at the East Tennessee Technology Park (ETTP) may have resulted in the disposal of used equipment and materials into Poplar Creek and the Clinch River. Although no firm documentation exists to support this, there is extensive anecdotal evidence and personal communication to warrant a survey of these two bodies of water in order to identify possible contaminated material. New technology allows the use of relatively inexpensive equipment, such as a side scan sonar, to identify underwater structures.

Surveys conducted in 2006 on the Clinch River from river miles 12 to 14 revealed only one anomalous structure located on the right descending bank at approximately CRM 13. This structure appeared to be a piece of concrete culvert. Surveys of Poplar Creek revealed a group of anomalous structures located at approximately PCM 1.9. There has not been a definitive identification of these structures. However, based on historical photographs, it appears that these structures are concrete culverts associated with a causeway constructed at that location circa 1945-1950.

Further surveys of the Clinch River, downstream of the confluence of Poplar Creek and the Clinch River (CRM 12), would be used to determine if the current has deposited any historical material downstream.

Methods

Using a Humminbird Model 987c SI side scanning sonar mounted on a boat, longitudinal transects will be made in the near shore areas of the Clinch River. These transects will be made such that they follow bottom contours as closely as possible (USACOE, 2004). The first transect will proceed downstream along the right descending bank. The second transect will proceed upstream along the left descending bank, thereby covering the unscanned portion missed on the downstream transect. At this time, it is proposed that transects be collected down to CRM 9.0. When an underwater structure is identified on the sonar, GPS coordinates will be recorded to mark the location. A description will be made of the area and further investigation will be conducted to determine if the structure is man made and if so, the nature of its source. If deemed necessary, water and sediment samples will also be taken from the immediate area to determine if the structure is contributing contaminants to the environment (ASTM 1990, TDEC 1999, EPA 1991). Actual sampling locations will be determined based on individual characteristics of any object detected and characteristics of the area where the object is located.

References

987c SI Installation and Operation Manual, Humminbird, Eufaula, AL, 2005.

Environmental Compliance Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region 4, Environmental Services Division, Atlanta, GA, 1991.

Hydrographic Survey Manual, U.S. Department of the Army, Army Corps of Engineers, Washington, D.C., 2004.

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EMWMF Storm Water Sampling

Introduction

Heavy rainfall events have the capability of transporting significant quantities of sediment into nearby bodies of water. This mass transport can, in turn, impact the quality of the receiving waters. Due to the extensive area of disturbed soils at the Environmental Management Waste Management Facility (EMWMF), sampling of the receiving waters for total residue would aid in determining the extent of their impact from the EMWMF.

To assess the degree of surface water impact caused by these rain events, samplings of NT4 (north tributary 4 of Bear Creek), NT5 (north tributary 5 of Bear Creek), and Bear Creek will be conducted following heavy rain events to determine the quantity of sediment being displaced. Two locations on Bear Creek will be sampled to determine the quantity of sediment deposited (above and below the intersections at NT4 and NT5). One sample will be collected on NT4 and one sample will be collected on NT5 to determine the quantity of material coming off the EMWMF.

In order to compare the relative contribution sediment load coming off the EMWMF, samples will be taken at Kerr Hollow Branch and the unnamed tributary just west of Kerr Hollow Branch. These sites are located below the sanitary landfills used by Y-12.

Methods and Materials

Samples will be collected as per Department of Health Standard Operating Procedures. Flow will be recorded from in-stream flow gauges already in place. Collected samples will be analyzed for total residue, delivered to the state lab and analyzed as per EPA procedures.

Schedule

The monitoring will be conducted within 24 hours following either a 1" rain event in a 24-hour period or a 2" rain event over a 72-hour period.

References

Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region IV, 960 College Station Road, Athens, Georgia. 1996.

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Ambient Trapped Sediment Monitoring

Introduction

Sediment samples will be collected with sediment traps quarterly at sites on the Clinch River and some of its tributaries. The sediment samples will be analyzed for organics, metals, and radiological contamination. The objective of this monitoring program is to assess the quantity and quality of the sediment that is being currently deposited in the Clinch River and some of its tributaries. Sampling site locations are shown in Table 1.

Table 1: Sample Locations

Site	Location	Clinch River Mile
8	Scarboro Creek	41.2
10	McCoy Branch	37.5
20	Grassy Creek	14.55
22	Unnamed stream (outfall of ETTP water plant)	14.45
6	Clinch River Mile 48.7 (Just upstream of skimmer wall at Bull Run Steam Plant)	48.7
29	Clinch River Mouth	0.0
*	Clinch River Mile 33 (Gallaher Bend)	33
*	Clinch River Mile 14.5 (near Grassy Creek)	14.5

*Streams yet to be numbered.

Methods and Materials

Parameters to be analyzed are as follows:

Inorganics: aluminum, arsenic, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, and zinc

Organics (extractables): butylbenzylphthalate, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, di-n-octylphthalate, diethylphthalate, dimethylphthalate, n-nitrosodimethylamine, n-nitrosodiphenylamine, n-nitroso-di-n-propylamine, isophorone, nitrobenzene, 2,4-dinitrotoluene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, bis(2-chloroethyl) ether, bis(2-chloroethoxy)methane, bis(2-chloroisopropyl) ether, 4-bromophenylphenyl ether, 4-chlorophenylphenylether, hexachlorocyclopentadiene, hexachlorobutadiene, hexachlorobenzene, hexachloroethane, 1,2,4-trichlorobenzene, 2-chloronapthalene, 4-chloro-3-methyl phenol, 2-chlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 4,6-dinitro-o-cresol, 2-nitrophenol, 4-nitrophenol, pentachlorophenol, phenol, 2,4,6-trichlorophenol

Organics (pesticides/PCBs): aldrin, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC (lindane), technical chlordane, alpha-chlordane, gamma-chlordane, 4,4-DDD, 4,4-DDE, 4,4-

DDT, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, endrin ketone, heptachlor, heptachlor epoxide, toxaphene, methoxychlor, PCB 1016/1242, PCB 1221, PCB 1232, PCB 1248, PCB 1254, PCB 1260, PCB 1262

Radiological: gross alpha (total), gross beta (total), gamma radionuclides: ^{137}Cs, ^{40}K, ^{214}Pb, ^{214}Bi, ^{212}Pb, ^{228}Ac, ^{208}Tl, ^{212}Bi and others as detected.

Schedule

The ambient-trapped sediment monitoring will be conducted in 2007. Traps will be placed and checked periodically to assess the rate of sediment deposition. Different sites are expected to have different rates of deposition. It may take as long as a year to accumulate enough sediment (10 grams dry weight) to be analyzed depending on rates of sediment deposition.

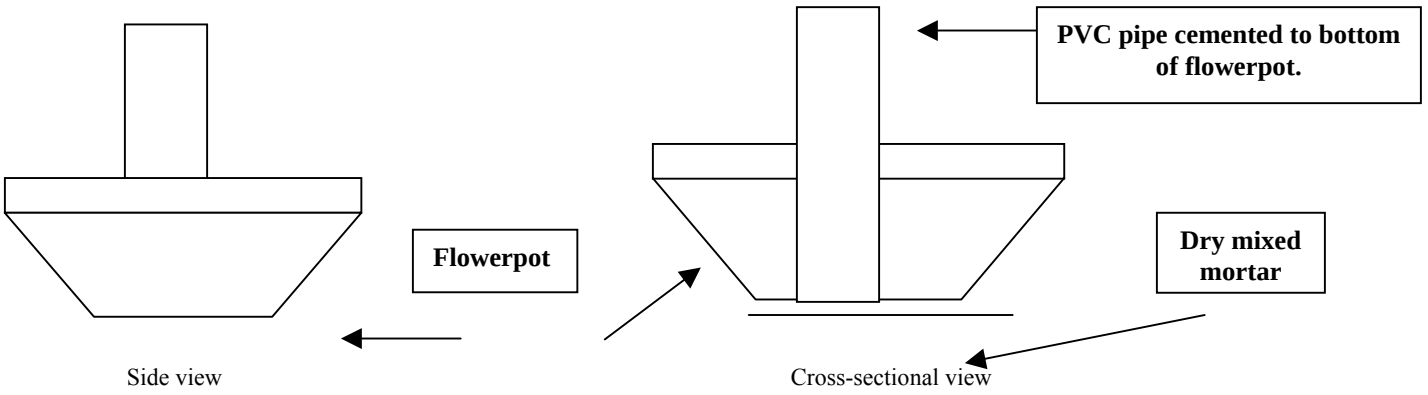
Sediment Standard Operating Procedures

Sediment analysis is a key component of environmental quality and impact assessment for rivers, streams, lakes, and impoundments. Samples can be collected for a variety of chemical, physical, toxicological and biological investigations. The procedures used obtain quality assured sediment sampling. The resulting data may be qualitative or quantitative in nature and is appropriate for use in preliminary surveys as well as confirmatory sampling.

Required Equipment

sampling platform/boat
depth finder
sediment traps
stainless steel mixing bowl
stainless steel spoon
pressurized water sprayer
deionized water
rubber gloves
aluminum foil
sample jars
sample labels
cooler/ice packs
scrubber
lab sheets
chain-of-custody forms
field notebook

Sediment Trap Design (Hargrave and Burns 1979)



Procedure
In the Clinch River sediment traps will be lowered into a suitable location on the river bottom and secured with a discretely placed wire cable. Tributary sediment traps will be placed by wading into the stream and positioning the sediment trap in a suitable location. Step by step directions are as follows:

Sediment trap sampling in streams

1. Locate a sampling site that is suitable for sediment deposition (low velocity and water pressure).
2. Don rubber gloves to avoid self-contamination during sampling.
3. Position the trap on the bottom; rocks or other objects may be used to weigh it down. Secure the trap to the bank with a steel cable or rope.
4. Check the trap quarterly and collect the sediment. Carefully transfer the sample into appropriate containers as directed by the Laboratory Services Services.
5. Record all pertinent information on lab sheets, sample labels, and in the field notebook.
6. Place all samples into cooler as soon as possible. Temperature within the cooler should be maintained at 4^{o} C by using ice or freezer packs.
7. Rinse all equipment using scrubber brush and sprayer filled with deionized water.
8. Deliver sediment samples to Laboratory Services within appropriate holding time frames, and sign chain-of-custody forms.

Sediment sampling in lakes or reservoirs

1. Don rubber gloves to avoid self-contamination during sediment sampling.
2. Secure weights to the sediment trap and slowly lower it into a suitable location.
3. Secure the trap to the shore discretely with steel cable.
4. Check the trap quarterly and collect the sediment. Carefully transfer the collected sediment into appropriate sampling jars as directed by the Laboratory Services.
5. Record all pertinent information on lab sheets, samples labels, and in the field notebook.
6. Place sediment samples into cooler as soon as possible. Temperature within the cooler should be maintained at 4^{o} C by using ice or freezer packs.
7. Rinse all equipment using scrubber brush and sprayer filled with deionized water.
8. Deliver samples to state lab within appropriate time frames. Be sure to sign all chain-of-custody forms.

Laboratory Services Procedures
Laboratory Services has expertise in a broad scope of services and analyses. This expertise is available to the Tennessee Department of Environment and Conservation (TDEC), Department of Energy Oversight Division (the division) and other TDEC divisions statewide. General sampling and analysis methods will follow Environmental Protection Agency (EPA) guidelines as listed in appropriate portions of Title 40 Code of Federal Regulations (CFR). Laboratory Services may subcontract out certain analyses and QC samples to independent laboratories. Bench level quality assurance/quality control (QA/QC) records and chain-of-custody records are maintained at Laboratory Services, as are QA records on subcontracted samples.

The division will primarily use the Knoxville branch of Laboratory Services. Wet chemistry and metals samples will be analyzed in Knoxville while organics samples will be sent on to Laboratory Services in Nashville. All Laboratory Services analyses will follow appropriate methods as documented in the Laboratory Services Inorganic Chemistry SOP and Organic Chemistry SOP. Specific analytical methods are covered in the Standard Operating Procedures (SOP) manuals for Laboratory Services. The SOPs direct analysts to the proper EPA or other methodology.

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